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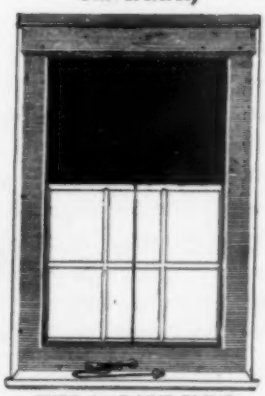

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Realistic Social Studies

IN so far as it will be concerned with realistic study of contemporary issues, the new Institute of Economic and Social Research under the direction of Prof. N. F. Hall, the formation of which was announced in NATURE of January 8, is a venture which has the warm support of many scientific workers. The joint contributions of the Halley Stewart Trust, the Pilgrim Fund, the Leverhulme Fund and the Rockefeller Foundation should guarantee enough for starting a modest programme, which will rehabilitate the prestige of social research in Great Britain, if the personnel and problems are wisely chosen.

Thirty years ago the voluminous and pioneer studies of the Webbs, and the foundation of the London School of Economics, aroused high hopes of a new temper of inquiry. The sequel has been disappointing. Since then, social studies in Britain have been dominated by the dreary and barren dialectical tradition of deductive economics. Like astronomy in the medieval universities, political economy in our leading centres of higher education is still following the trail of self-evident principles. This being so, it is not surprising that responsible bodies which administer funds for research have been loth to make large allocations to university departments, or have refused to renew temporary grants such as the Rockefeller subsidy to the London School.

In his recent farewell address to the latter, Sir William Beveridge compared the state of the social sciences to anatomy before Harvey. Without immodesty, he might have drawn a moral from the generation which followed Harvey's work. The most conspicuous example of healthy growth in contemporary social research is the study of population on the lines initiated by three men whose names appear on the list of original fellows of the Royal Society. The pioneers of British demography were Graunt, Sir William Petty and Halley. Graunt figures as the "ingenious author of the Mortality Bills" in the first history of the Society by Sprat, Lord Bishop of Rochester. Halley published the first life table, in the *Philosophical Transactions* of 1693. Since the first meetings of the 'Invisible College' were in Petty's rooms, the author of the "Politicall Arithmetick" shares with the "father of chemistry and the uncle of the Earl of Cork" the honour of being one of the first parents of the Society. Thus quantitative and realistic social inquiries shared in the efflorescence which followed Harvey's death.

After the lapse of little more than a century, Bentham exclaimed, "compare the state of chemistry then and now!" He might well do so. Chemistry in Bentham's time had just thrown off the self-evident principles involved in phlogistonism, and demography had taken up the self-evident principles of the gloomy parson. In his own day, Bentham's appeal for the reunion of naturalistic and humanistic inquiry made no ripple on the complacency of classical humanism in the established seats of learning, where the teaching of natural science prompted Babbage, Lucasian professor in the Newtonian succession, to write "The Decline of Science in England". No twentieth-century Babbage has appeared to compose a new "Economy of Manufactures".

Still, there are new signs of uneasiness about humanistic studies, and researches on population have become the focus of a new *rapprochement* between natural science and social studies. As in the times of Graunt, Halley and Petty, the new

school of research draws its personnel from workers trained in the former. Revival of interest in population problems in Britain was initiated by the influence of two men. Sir William Beveridge graduated in astronomy: Carr-Saunders, his successor at the London School, was a professional biologist at an earlier stage in his career. The most challenging investigation of the British prospect has been that of Dr. Enid Charles in the Department of Social Biology of the School.

Such reflections might well justify the hope that the new Institute will welcome advice from men of science and recruit its personnel from scientific workers. So far, we have had no indication that it will. This is the more curious in view of the place which Sir Josiah Stamp occupies as its new president. In his British Association address, Sir Josiah urged, and rightly urged, that the "Impact of Science on Society" is the central theme of fruitful inquiry into current affairs. To his recently published volume of addresses he has added an appendix on research finance prepared for him by one of his scientific friends. None should know better the relevance of naturalistic knowledge to contemporary social research, and none should know better the value of closer co-operation between those engaged in realistic social inquiries and those who have a wide experience of the financial needs of large-scale research work. If the new Institute is going to tackle the fundamental problems arising from the way in which expanding technical resources react upon, and are used by, existing social institutions, the existing departments of economics in our universities will not supply the recruits which it needs most. If it is not going to tackle these problems, it will do little to reinstate confidence in social research under academic auspices.

Elementary Geometrical Optics

(1) Practical Physics for Inter. B.Sc. Students
By Dr. H. M. Browning and L. Starbuck. Pp. x + 146. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1936.) 3*s*. 6*d*. net.

(2) A Textbook of Light
By L. R. Middleton. Second edition. Pp. viii + 288. (London: G. Bell and Sons, Ltd., 1937.) 6*s*.

(3) Light
By Vivian T. Saunders. Third edition. Pp. vii + 328. (London: John Murray, 1937.) 6*s*.

(4) A Textbook of Light
By G. R. Noakes. Pp. viii + 355. (London: Macmillan and Co., Ltd.; 1937.) 6*s*.

(5) Elementary Physics:
for Medical, First Year University Science Students and General Use in Schools. By G. Stead. Fifth edition. Pp. xv + 559. (London: J. and A. Churchill, Ltd., 1936.) 12*s*. 6*d*.

(6) College Physics
By Prof. John A. Eldridge. Pp. x + 616. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 18*s*. 6*d*. net.

IN 1934 a committee of the Physical Society published a valuable report on the teaching of geometrical optics. The committee made a unanimous recommendation with regard to the convention to be observed for the sign of the power of an optical system. This convention is universal among opticians, and may be expressed briefly by saying that a positive lens tends to converge and a negative lens to diverge the light. A more difficult problem to solve is that of obtaining agreement as to the sign conventions to be adopted when discussing the relations between object and image. Two alternative methods were advocated, which may be called the Cartesian and the non-Cartesian systems.

The committee expressed the opinion that the preference for one or other of these systems in elementary teaching should rest on experience with both in the schools. It is accordingly a matter of interest, and indeed of considerable importance, to determine to what extent older conventions have been discarded and which of the proposed alternatives seems likely to be adopted. Most of the school text-books, and those used in junior university courses, formerly agreed in assigning a negative focal length to a converging thin lens. Distances on one side of the lens were considered positive, those on the other side negative, and distances were considered positive when measured in a direction towards the source of light.

(1) This 'old' convention, which we shall call convention *A*, is still employed in the recently published "Practical Physics" for Intermediate Science students written by Browning and Starbuck. (2) In the second (revised) edition of his "Textbook of Light", Mr. Middleton, of Latymer Upper School, has done a useful piece of work

by showing side by side the results of using three sign conventions. He retains the 'old' or *A* convention, and also introduces the new sign conventions recommended in the report of the Physical Society with the view of giving a positive focal length to a converging thin lens. The convention which he calls *B* differs from *A* in that distances are counted positive when measured from the pole in the same direction as that in which the incident light travels. Thus *A* corresponds to Group I, Case 2, of the report, and *B* to Group I, Case 1. Both of these conventions are based on the Cartesian framework. The third convention, which Mr. Middleton calls *C*, corresponds to Group II, Case 1, of the report. "Distances are measured from the mirror or lens and are counted positive if actually traversed by the light, but negative if the light only appears to travel in that direction. Thus for a real image v is positive, and for a virtual image v is negative. Also concave mirrors and convex lenses have positive focal lengths, while convex mirrors and concave lenses have negative focal lengths."

In the report the last method of dealing with optical problems is described as a "non-Cartesian" system. In view of the fact that stress is laid on a clear distinction between "object space" and "image space", I suggest that this may be called a "spatial" system, and convention *C* (that is Group II, Case 1) the "spatial" convention. It should, however, be noted that it is possible to develop the relations between object and image without express reference to these "spaces" (which may confuse a beginner), and this is the plan adopted in the above and some other books.

As illustrating Mr. Middleton's presentation we may quote his equations for a thin lens. It is, of course, obvious to the teacher that equations involving only reciprocals of a distance

Convention *A*	Convention *B*	Convention *C*
$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$	$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$	$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$
$^{1}=\left(\mu-1\right)\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$	$\frac{1}{f}=\left(\mu-1\right)\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$	$\frac{1}{f}=\left(\mu-1\right)\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$

must have the same form under convention *A* as under convention *B*, since the sign of each distance has been reversed.

For a spherical mirror all three conventions lead to the same general formula:

$$\frac{1}{v}+\frac{1}{u}=\frac{2}{r}=\frac{1}{f}.$$

The author emphasizes the fact that it is only necessary for the student to know, and understand, one of these conventions. The value of the comparisons will be appreciated rather by the teacher, who wishes to make his choice between the conventions, than by the beginner, who may feel some alarm at their abundance.

(3) In the third edition of "Light", by Mr. Saunders, of Uppingham School, the sign convention used in geometrical optics "conforms to the convention used in algebraic graphs" and makes a convex lens have a positive focal length. The diagrams are drawn with the light moving from left to right across the paper (Convention *B*). Incidentally, mention may be made of the very interesting historical references in this book, and also of the chart of electromagnetic waves included by permission of the Royal Society.

(4) Mr. Noakes, of Giggleswick School, has written a "Textbook of Light" for the use of sixth-form students who are specializing in science. He has adopted many of the suggestions of the 1934 report, and in particular uses one of the two alternatives there recommended (Convention *C*). All real distances are reckoned positive, and all virtual distances negative; the focal length of a converging lens is thus positive. His conclusion is: "My experience with this sign convention has so far been that pupils consider it much less artificial than the Cartesian system, employed in most older text-books, and that the average careful worker makes fewer slips".

In view of the opinion of the committee of the Physical Society that actual experience in schools should be a deciding factor between the two alternatives, Cartesian or spatial, this conclusion is of special importance, and it is very desirable that it should be confirmed by other teachers. It agrees with the remarks of Mr. Vinycomb in the Physical Society discussion (p. 77), who found that elementary students were more successful with conventions of sign depending upon the real or virtual character of the object and image.

Why, it may be asked, should fewer mistakes occur when the "spatial" convention is employed by beginners? One reason is that the distinction between the object space and the image space itself takes care, to a large extent, of the question of sign. This is shown by the fact that the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$ applies to both mirrors and lenses. With the older (Cartesian) conventions a separate formula $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$ is required for lenses, and it is necessary for the pupil to remember which formula applies to the lens and also to associate the letter u with the object and v with the image. There are thus two distinct possibilities of confusion in the mind of the beginner.

(5) In the fifth edition of Stead's "Elementary Physics", in which stress is laid on medical applications, the author states that he has adopted a new sign convention for lenses partly because of the support for the proposals of the committee of the Physical Society given by many members of the Science Masters' Association. "I confess that I have done this with some reluctance, as I am not altogether convinced of the wisdom of the change, so far as elementary students are concerned, but it has at least the advantage of giving the same standard formula for lenses and mirrors, and of bringing the signs of lens powers into line with those used by opticians and ophthalmic surgeons". The convention as to signs for thin lenses is expressed as follows (§ 232): "All distances are measured from the centre of the lens *C*. The distance from *C* of a real object or image is counted as positive, and the distance of a virtual object or image is negative. Since a convex lens has a real focus its focal length is positive; similarly the focal length of a concave lens is negative." The convention is essentially the same as that adopted by the author for mirrors (§ 215).

The curvature method advocated several years ago by Dr. C. V. Drysdale is both interesting and instructive, but my experience in teaching first-year university students has been that lack of time prevents more than a very brief reference to this method of treatment. It seems probable that schoolboys beginning the subject of light will think more easily in distances than in curvatures, and more advanced students can take up the curvature idea at a later stage after having had a taste of wave theory.

A stimulating, and in places provocative, book on "Physics for Medical Students" has been written by Mr. W. H. White, "one who has had time to learn how". On page 416 he writes: "The study of thin lenses is commonly carried on under the shadow of an algebraic convention as to 'sign' which makes distances measured opposite ways from the lens opposite in sign. That sounds simple and rational enough, and so it is from the point of view of geometry, but it has not the slightest physical basis". He aims at giving a physical meaning to + and − by picturing plane waves of sunlight falling on a lens (burning glass) and becoming curved to circular ripples which all close in on the burning focus *F*. Translated into 'rays', parallel rays become convergent radii which all pass through *F*. A concave lens has the effect of making parallel rays divergent. This leads up to the explanation of the focal power of a lens.

(6) It is interesting to find that in a new American book, "College Physics" by Prof. John A. Eldridge of the University of Iowa, the wave method is applied for finding the focal length of a double convex lens, and the rule of signs employed for mirrors and lenses corresponds fairly closely with convention *C*. This is a useful book for a student with only a general interest in physics, and yet should give a solid foundation for those intending to take a professional training at a later stage.

Which convention ought to be adopted?

Apart from the fact that such a phrase as 'Cartesian co-ordinate system' is alarming to a beginner, too rigid an adherence to a Cartesian framework may defeat its own aims, as, for example, when two students are working on opposite sides of a laboratory table, one having the source of light on the right, the other on the left!

In favour of convention *A*, as against convention *B*, it may be argued that this makes the co-ordinate u of the object, the first quantity to be dealt with, positive. The more negative quantities there are in u,v,f, the greater is the chance of error. In the greater number of problems set the object is given and either v or f is required. There is an advantage, therefore, in having u positive. Again, in the simple case of a real image formed by a concave spherical mirror (usually one of the first to be treated) the distances u, v, f are all positive according to convention *A*, but with convention *B* they are all negative.

If we consider the choice of our convention from the point of view of the teacher of elementary students, it would seem that convention *C* is to be preferred to convention *B*, in so far as there is less risk of mistakes in sign. The spatial convention does, however, strictly involve distinction between real and virtual spaces and so may cause confusion. The 'existence' of virtual images does present a difficulty to some minds, and there is the additional trouble that the student does not always know whether the image is going to be virtual or not. The difficulty is even greater to such minds when problems involving a 'virtual object' come to be dealt with.

Under present conditions, with so many methods of treatment in use, the outlook for a student or a science master who is transferred from one school to another is not an inviting one, and the task of an examiner who has to mark questions in optics answered by candidates from different schools becomes well-nigh impossible. It is to be hoped that teachers of physics will speedily reach agreement as to the convention to be used by elementary students. Personally I began the examination of this question with a prejudice, shared by many others, in favour of the 'old' convention *A*, but if we are compelled to follow the opticians' terminology the present survey points towards the adoption of *C*, the "spatial" convention, rather than *B*, the "Cartesian" convention.

H. S. ALLEN.

The Experimental Production of Mutations

Experimentelle Mutationsforschung in der Vererbungslehre
Beeinflussung der Erbanlagen durch Strahlung und andere Faktoren. Von N. W. Timoféeff-Ressovsky. (Wissenschaftliche Forschungsberichte: Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 42.) Pp. x + 181 + 6 plates. (Dresden und Leipzig: Theodor Steinkopff, 1937.) 15 gold marks.

THE last decade has seen remarkable activity in the experimental production of mutations in animals and plants, chiefly through the agency of X-rays but also by the application of various other radiations, as well as by chemicals and by temperature effects. When the range of dosage was determined within which the cell and particularly the chromosomes could be bombarded without an immediate lethal effect, the way was open for unlimited experimentation in the production of new genetic types through a direct effect on the germ-plasm.

So early as 1907–8, experiments were published showing the effects of X-ray treatment on the sperm of toads and rabbits, and Gager obtained evidence of mutations resulting in plants from the action of X-rays and radium. But success on a large scale first came from the work of Muller on *Drosophila* in 1927. The subsequent literature of the subject has become extensive, as indicated by the 27 pages of bibliography in the present volume. This experimental work has contributed much to the development of the conception of the gene, although, of course, natural mutations are of at least equal value in this respect.

Timoféeff-Ressovsky has contributed to all aspects of this work during the past ten years, and he has shown special interest in the nature of the gene from a physico-chemical point of view. It is therefore natural that he should have produced a book on this subject which is of great interest and analytical value. The work contains ten chapters. After four chapters of an introductory and general character, three are devoted to analysis of the processes by which mutations are produced by short wave-length radiation. Here *Drosophila* naturally looms large as having been most intensively studied, but the work of Stadler on cereals, Stubbe on *Antirrhinum*, and many other results are also considered.

Another chapter, on the effects of temperature, chemical treatment and other factors, is followed by one on gene structure, in which step-allelomorphism and the 'position-effect' are discussed, and the process of mutation is subjected to biophysical analysis. Evidence is produced for the conclusion that some mutations are the result of a very small rearrangement of the genes (position-effect), similar to inversions and translocations but on a smaller scale.

A final chapter considers the applications of the results to theoretical genetics, the chromosome theory and the phenomena of somatic induction, as well as the practical applications to experimental breeding and to man. The author may be assured that his book will be of much service not only to those engaged in this experimental field but also to all who are interested in modern genetical theory.

R. RUGGLES GATES.

Tables for Air Navigation

The Air Almanac
Prepared by H.M. Nautical Almanac Office on behalf of the Air Ministry. (Air Publication 1602.) Pp. 16. 2*s*. 6*d*. net. Ephemeral Sheets for 1937, October 1 to December 31. (Air Publication 1602A.) Pp. 92. 2*s*. 6*d*. net. (London: H.M. Stationery Office, 1937.)

THE growing importance of astronomical observation in air navigation, as a result of the increasing range of aircraft, is reflected by the recent publication of an "Air Almanac", specially designed to meet the requirements of air navigation. The "Abridged Nautical Almanac" already gives to the surface navigator the astronomical data required to an accuracy of 0·1′ or 0·2′, but involves certain interpolations and conversions that can be avoided in an almanac catering only for one tenth of this accuracy, which is that appropriate to the conditions of observation with a bubble sextant in aircraft. This lower degree of accuracy gives the air navigator his position with all the precision that he needs. His prime requirement is rapidity in the working up of a sight.

The most interesting feature of the "Air Almanac" from this point of view is the tabulation of the Greenwich hour angle in arc, instead of the right ascension in time, thus giving directly the quantity that the navigator desires, without subsequent conversion. This method of tabulation normally involves large differences and heavy interpolations; but the small intervals of tabulation adopted, namely, one hour for the sun and moon, six hours for the planets and ten minutes for the sidereal time or Greenwich hour angle of the First Point of Aries, have made possible considerable simplification.

The "Air Almanac" has been designed to give all essential information in light, compact and easily readable form, with page references and interpolations reduced to a minimum. This has been achieved by issuing the "Almanac" in two parts, one of which consists of a stout permanent binding containing all the permanent data and tables, together with short explanations and illustrations; and the other consisting of loose sheets, each of which contains all the necessary ephemeral data for two days for the sun, moon, Venus, Mars, Jupiter, Saturn and fifty bright stars. The ephemeral sheets are punched for easy attachment to a loose hinge in the permanent cover. When one of these sheets is in position, the necessary astronomical data together with suitable interpolation tables are available in the space of a few pages. This reduces the bulk and greatly facilitates reference. Thus, though the ephemeral sheets for one year considerably exceed the "Abridged Nautical Almanac" in bulk, in consequence of the method in which the data are presented it is never necessary for the air navigator to carry more than a few sheets at any time.

Apart from the primary use for air navigation, it is certain that considerable interest will be expressed in the possibility of using the "Air Almanac" for surface navigation and also for incorporating afterwards similar ideas in the "Abridged Nautical Almanac". For the traveller in remote parts, a small bubble sextant in conjunction with the "Air Almanac" will suffice to fix his position with the accuracy that he usually needs.

The "Air Almanac" has been produced by H.M. Nautical Almanac Office to the general requirements of the Air Ministry, by agreement with the Admiralty. It is published by H.M. Stationery Office under the Code Air Publication 1602 for the permanent portion and 1602A for the ephemeral sheets. The first issue of the ephemeral sheets was for the period October 1–December 31, 1937. These sheets are to be issued in advance at first quarterly, later at intervals of six months, and finally annually.

Theory of Statistics

An Introduction to the Theory of Statistics

By G. Udny Yule and M. G. Kendall. Eleventh edition, revised throughout and re-set. (Griffin's Scientific Text-Books.) Pp. xiii + 570. (London: Charles Griffin and Co., Ltd., 1937.) 21*s.* net.

MR. UDNY YULE'S "Introduction" was the first book on statistics that came into my hands. This was about 1916. I liked it then and learned a lot from it. I like it even more now in its eleventh edition, when it appears in a revised and supplemented form. In fact, in my opinion, this is the best book on the theory of statistics that was ever written. We may regret only that it is an elementary introduction to the theory of statistics and not the theory itself. This still remains to be written.

The authors make a distinction between books on the 'theory of statistics' and those on 'statistical method'. They do not discuss this distinction in the text but emphasize its importance in classifying the existing literature (p. 496). The words "Theory" or "An Introduction to the Theory", etc., suggest a system of conceptions and theorems properly defined and proved. Some of the results thus obtained may be directly used for applications; but the main purpose of the whole is to broaden the horizon of the reader and to make him understand the purpose and the real meaning of 'recipes' that he may find in books on "Methods". It is true that the classification of the existing literature from this point of view could not be objectively distinct, since every book "on Methods" does give, or attempts to give, some explanation of what the reader is recommended to calculate. Whether these attempts are sufficient in any particular case is a matter of opinion, and it is possible that the classification as offered by Yule and Kendall will not be generally accepted. But the idea of the distinction itself and also the desirability of more books on the 'theory' seem to be important.

However difficult it is at present to write a book on the theory of statistics, it is still more

difficult to produce an elementary "Introduction to . . ." "The Theory" implies a unicity of the basic ideas, in fact a system, as we have systems of geometries, Euclidean, Lobatchevsky-Boliay'an and Riemannian. Such a unified system of statistics, including all the recent advances, does not exist yet, and the writer on the subject must first produce one and then describe it in an intelligible way. These are the difficulties in writing a "Theory".

When writing "An Introduction", these difficulties are somewhat diminished by the fact that the system to be produced and described need not be so broad and may omit the more recent results. But there are other specific difficulties, to present the system without elaborate tools of higher analysis.

In this task the authors have succeeded admirably. They have produced a system of conceptions and their consequences, reaching as far as some of the quite modern tests of significance. They insist on definitions and are careful to use the words in their defined meaning. They even produce lists of defined terms used by other writers. When leaving out some results which are too difficult to be produced or omitting some proofs, they do it in a way which permits the reader to distinguish between what he knows and what he does not. This may seem only conventional praise. To understand its importance the reader may wish to consult some of the popular books on the "Methods" where, instead of properly ordered definitions and deductions, he will frequently find a sort of mystic gospel full of mysterious terms and impressive formulæ.

The new edition of the "Introduction" differs considerably from the preceding ones. The difference consists mainly in numerous smaller additions disseminated abundantly throughout the book and of several new large chapters. As stated in the preface, one of them, on interpolation and graduation, is due to Mr. Udny Yule himself. The others, on sampling, including an introductory chapter on small samples, on moments and measures of skewness and kurtosis and on the method of least squares have been written by Mr. Kendall. Probably owing to a close collaboration between the two authors, their respective contributions fit very well together and form a harmonic whole.

A noteworthy innovation in the book is a set of the most important numerical tables and a diagram (pp. 531–541) which are needed in any serious statistical work.

As in former editions, there are numerous examples discussed in the text and also "exercises". There are various problems attached to every chapter, which the student will find useful. The solutions of these problems are given in a special section at the end of the book.

The list of references given in the book contains 680 entries. It goes as far as 1932 and is not considered by the authors as complete. It seems, however, a pity that while quoting twelve books on probability, the authors do not refer to the work of the very important present-day French School. There is no reference to E. Borel's "Traité du Calcul des Probabilités", composed of about a dozen volumes, contributed either by Borel himself or by his various collaborators. There is no reference either to the important book by Paul Lévy.

There are a few minor points on which I am inclined to disagree with the authors. Of these it may be perhaps worth while to mention the definition of the word statistics. The authors write (p. 3), "By Statistics we mean quantitative data affected to a marked extent by a multiplicity of causes. By Statistical Methods we mean methods specially adapted to the elucidation of quantitative data affected by a multiplicity of causes. By Theory of Statistics or, more briefly, Statistics, we mean the exposition of statistical methods".

Naturally every author may choose the definition he likes, but it seems to me that the whole book under review has been written as if the authors had in mind another definition of statistics, that suggested by the German term *Kollektivmasslehre*. In fact, whatever they discuss is either the properties of some *Kollektivmass* (= collective character !), such as the frequency distribution, measures of contingency, that of skewness, etc., or the means by which such a *Kollektivmass* of an inaccessible universe may be estimated from the sample available. The question of the "multiplicity of causes" seems to arise only before and after a statistical inquiry in the strict sense of the phrase.

Instances of this are given in a very interesting chapter (xv) on illustrations and practical methods. Having to solve some particular social (or any other, agricultural, physical, etc.) problem, we start by discussing the multiplicity of causes and, as it were, translate the problem into statistical terms. Then follows the statistical work proper and, when it is completed, we return again to draw conclusions concerning the causes. But these two phases of the inquiry, the first and the last, seem to belong rather to sociology, economics, agriculture or whatever may be the branch of science to which statistical methods are applied, but not to the statistics itself.

We may conclude by expressing the hope that the book in its new form will have a very wide circulation.

J. NEYMAN.

Gold Deposits of the World:
with a Section on Prospecting. By Prof. William Harvey Emmons. Pp. vii+562. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36*s*.

PROF. EMMONS'S name is sufficient guarantee that a book from him merits serious consideration. In this work, an "Introduction", which is rather fuller than such chapters are wont to be, will be found helpful to many students and to some who have passed the student stage, especially in the elucidation of bathyliths and their relation to gold deposition. Excluding this and the index, which occupies eighteen pages, half the book is taken up in descriptions of American gold occurrences, and the balance is left for the remainder of the world. It is this latter half that is open to criticism. For so dominant a producer as the Rand, more up-to-date figures might have been given for individual mines as regards values, widths, working costs and tonnage. For example, one diagram is based on assays made in 1913: the recent developments in which West Witwatersrand Areas, Ltd. has so prominently figured are almost passed over, and the plan of the Rand printed on p. 421 is too small and confused to be of much value. The absence of recent data is noticeable throughout this part of the book; thus it is stated that, "No production is reported for Sierra Leone", whereas the Colonial Report for 1935 gives "32,947 ozs. (crude)"; that in Tanganyika Territory the area north-east of Mwanza is unmapped, whereas excellent geological maps were published a few years ago.

In dealing with America, Prof. Emmons is on surer ground and writes fully with an authoritative hand. The descriptions of the mines are backed by an immense series of facts and figures, and throughout, with rare exceptions, the maps and diagrams, of necessity small, are admirable and sufficiently clear. Plentiful references to earlier works are given. The chapter on "Prospecting" contains some useful notes on controlling structures and references to examples in the text, but the author has not extended this part of his subject to descriptions or discussions of mechanical or geophysical methods. Despite the relatively small defects mentioned, this comprehensive volume will undoubtedly prove of great value to all interested in the geological and economic aspects of its subject. J. P.

The Fauna of British India, including Ceylon and Burma
Edited by Lt.-Col. R. B. S. Sewell. (Published under the authority of the Secretary of State for India in Council.) Protozoa: Ciliophora. By Dr. B. L. Bhatia. Pp. xxii+493+12 plates. (London: Taylor and Francis, 1936.) 30*s*.

THE present volume, one of the latest in the series on "The Fauna of British India, including Ceylon and Burma", though devoted only to those members of the sub-phylum Ciliophora, or ciliate infusoria, which have been recorded from the countries named, will be of more general interest to zoologists, in view of the cosmopolitan distribution of the majority of these Protozoa, and also because there is no recent publication in the English language dealing with this group in a comprehensive manner. This work represents a systematic survey of the Ciliophora, of which 310 species, including several new ones, are briefly described. The classification of the group adopted by Dr. Bhatia is up to date. Keys are provided for the identification of families (including those hitherto not recorded from India), genera and species. A useful "Systematic Index" combines a résumé with a classified list of the organisms dealt with. The ciliate species are also arranged in groups, according to their geographical distribution, while cross-reference lists are given for the parasitic forms and their hosts. A brief description is given of the general morphology of the Ciliophora and of the methods employed in their study.

There is an exhaustive bibliography occupying 46 pages and an alphabetical list of the ciliates referred to in the book, as well as a map of the Indian Empire. The volume is abundantly illustrated by text-figures and twelve plates. The latter represent the Ophryoscolecidæ found in the Indian ox and are reproduced from Kofoid and MacLennan's studies on these ciliates. It is somewhat surprising to find that, in a book devoted to the entire sub-phylum Ciliophora, all the plates are allocated to the representatives of a single family. C. A. HOARE.

The Scenery of England:
a Study of Harmonious Grouping in Town and Country. By Dr. Vaughan Cornish. Second edition. Pp. xvi+144+15 plates. (London: Alexander Maclehose and Co., 1937.) 6*s*. net.

DR. VAUGHAN CORNISH is an eminent example of the type of observer who not only appreciates the best characteristics of the works of Nature and of man but also interprets them with scientific understanding. The first edition of his charming little book was noticed in NATURE of November 19, 1932 (130, 760); and we are glad to direct attention to this new issue, which contains an appendix by Mr. H. G. Griffin, secretary of the Council for the Preservation of Rural England, on the aims and objects of the Council. The book has been enlarged and revised, and ten of the fifteen full-page plates in it are entirely new. The picture of the tidal bore of the Trent at Knaith, above Gainsborough, a subject to which Dr. Cornish has given particular attention, is remarkably fine. Every intelligent lover of 'open-air' scenes in town or country will find the book a source of real pleasure.

Earth-Lore:
Geology without Jargon. By Prof. S. J. Shand. Second edition, revised and enlarged. Pp. viii+144+16 plates. (London: Thomas Murby and Co., 1937.) 3*s*. 6*d*. net.

"GEOLOGY WITHOUT JARGON" aptly describes Prof. Shand's entertaining and informative little book. The second edition has been improved by the addition of a number of plates and other illustrations; and there is a new chapter on Atlantis and other "Lost Continents".

Exploration of the Electric Field in Clouds

THAT there is electricity in the clouds has been realized since 1755, when sparks were drawn from the insulated rod set up by D'Alibard and from Franklin's kite, but the problem how to determine with certainty where the electrification was situated had been left unsolved until a method was suggested by Sir George Simpson three years ago and developed at Kew Observatory by Mr. F. J. Scrase.

There has, it is true, been much speculation on the subject, speculation depending on the records of potential near the ground and especially on measurements of the change of gradient produced by lightning flashes. The problem, given the distribution of electricity, deduce the strength of the electric force at a certain point, is easily solved; but the converse problem, given the electric force at a single point, find the distribution, is not soluble. Even if we knew the electric force at every point on the ground, we could not determine the distribution of electricity in the clouds and in the air below the clouds. That is why the interpretation placed upon his records by an investigator has not necessarily been acceptable to his colleagues, and there has been much room for controversy. To gain more intimate knowledge of the state of things in the clouds it was necessary to send up into the clouds apparatus suitable for the purpose. I do not think that this was fully appreciated by anyone until we had tried at Kew Observatory to learn the meaning of the potential gradient records obtained in disturbed weather and had to admit that we were baffled by the ambiguities.

Electrometers had already been sent up in sounding balloons. In 1926 and 1927, Idrac measured the potential gradient in fine weather by means of a valve electrometer and a milliammeter, the indications of which were photographed, but none of his soundings was made through big clouds, and after his untimely death the investigation, which had been carried out at Trappes, was discontinued. For the work at Kew it was anticipated that numerous instruments would be required and they had to be as simple as possible. Sir George Simpson pointed out that it was more important to find the sign of the potential gradient than to measure it, and suggested the use of pole-finding paper. That idea was speedily developed, and the first alti-electrograph was sent up a few weeks later. This rapid advance was possible because Mr. L. H. G. Dines had already designed for Sir George Simpson a meteorograph which was intended to detect the presence of vigorous vertical air currents in the clouds. It was only necessary to put on the same spindle as the disk on which the pressure was recorded another disk carrying a piece of prepared paper. During the next two years, some seventy alti-electrographs were sent up from the Observatory.

During an ascent, the electrograph is in series with a pendant wire about twenty metres long, from the end of which there is point discharge whenever the electric field is strong. Two pin-points make contact with paper impregnated with a solution containing potassium ferrocyanide, and a blue trace is made by one pin or the other as the potential gradient is positive or negative. It was soon found that the thickness of the trace depended on the strength of the gradient, so the records are to a certain extent quantitative as well as qualitative. Most of the ascents were made during thunderstorms or thundery showers, the voltameter not being sensitive to the potential gradients in the clouds which yield moderate rain. To diminish the risk of the alti-electrograph being carried out to sea, a Baker release was used so that the apparatus would be carried down by a parachute from a height of a few kilometres.

The records have been analysed by Sir George Simpson and Mr. Scrase, and their conclusions are set out in a paper recently published by the Royal Society (*Proc. Roy. Soc.*, A, 161, 309–352, August 1937). Some of the balloons sent up were not recovered, and in many cases the electric field was not strong enough to be recorded; but for the period up to the end of 1936 there were thirty-one records available for discussion. Most of the soundings had reached heights of about 7 km. as was intended, but in two cases the balloons had ascended to much greater heights, 15 km. and 17 km., and recorded strong gradients in the stratosphere.

At first glance there is much diversity in the records, but the analysis has yielded a number of valuable generalizations. The first is that in practically every ascent there is a change in the sign of the potential gradient. This is an indication that the balloon passed from below to above a region of concentrated charge. The second generalization is that the location of the charges is related to the temperature of the cloud. These two conclusions are illustrated in a very instructive diagram (Fig. 1).

In this diagram the ascents were arranged in order according to the height at which the

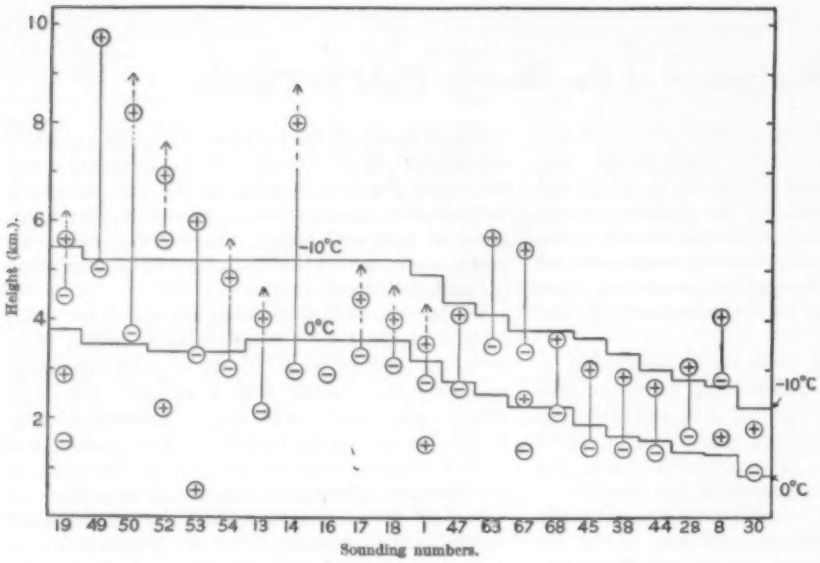

Fig. 1.

HEIGHT OF CENTRES OF RAIN ELECTRICAL CHARGES. FROM *Proc. Roy. Soc.*, A, 161, 309–352 (1937).

temperature (calculated by assigning reasonable values to the lapse-rate below and in the cloud) was −10° C.

It will be seen that in every case there was evidence for a positive charge near the greatest height reached by the sounding, and, moreover, this positive charge was always in a region where the temperature was below the freezing point. Clearly, positive electrification is developed in the part of the cloud where there is snow and possibly hail. The complementary negative charge is generally near the bottom of the cloud. There are, however, a few cases in which there is a concentration of positive electricity at a low level, an indication that there is a second process at work in the part of the cloud where the snow has melted into raindrops.

Hitherto, in most discussions of the possible ways of generating electricity in the clouds, attention has been concentrated on the behaviour of raindrops, in spite of the fact that the thunder-cloud is usually capped by false cirrus and in spite of the general acceptance in recent years of the doctrine, strongly advocated by Bergeron, that rain is nearly always melted snow. The discovery that electrification is produced in the region in which there is snow recalls, however, the early theory of thunderstorms developed by L. Sohncke, of Munich, in a pamphlet published at Jena in 1885 (cf. *Met. Z.*, **5**, 413–425; 1888). Sohncke maintained that the electrification was produced by friction between ice and water, the ice acquiring a positive charge, the water a negative charge. If this theory had been correct, the negative charge on the cloud particles would have been carried upwards by convection currents and the snow would have carried a positive charge downwards. Actually the positive charge is found at the top of the cloud, so Sohncke's theory cannot be valid.

Simpson and Scrase remark that when there is driving snow near the ground, a strong positive gradient is developed. This was demonstrated by Simpson in the Antarctic and confirmed by Sverdrup during the voyage of the *Maud* in the Arctic

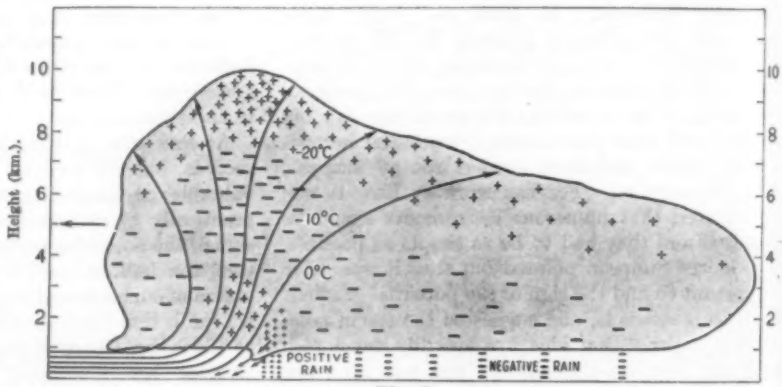

Fig. 2.

GENERALIZED DIAGRAM SHOWING AIR CURRENTS AND DISTRIBUTION OF ELECTRICITY IN A TYPICAL HEAT THUNDERSTORM. FROM *Proc. Roy. Soc.* A, 161, 309–352 (1937).

Ocean. It is likely that when snow particles collide, the particles acquire a negative charge, whilst a positive charge is given to the air. The snow falls to the ground and a positive space charge remains in the air and may extend to a considerable height. The process is analogous to what happens in a sandstorm, though the sign of the electrification is reversed. Thus it is to be expected that in the part of a cloud where there are snow particles in violent motion there will be electrification, that the snow will carry down a negative charge and that the air streaming upwards will take a positive charge to the top of the cloud, this charge being communicated rapidly to the cloud particles. It may be added that as the cloud-top is in a region where the conductivity is high, a strong current of positive electricity can flow upwards to the Heaviside layer, so providing (in accordance with Wilson's theory) for the air–earth current of fine weather.

There is some evidence that the regions in which positive electrification is produced low down in the clouds are those where the rain is heaviest, and Simpson and Scrase hold that the breaking-drop theory of the former is the explanation of this electrification. As the snow melts, it forms large drops, and if these are too large for stability they will break up. The rising current of air will carry a negative charge and the positively charged droplets fall or perhaps remain nearly stationary. The hypothesis that this process occurs only where the upward current is strong is embodied in Fig. 2.

Perhaps the most surprising result of the investigation is that no evidence is found for very strong fields in the clouds. The magnitude of the potential gradient is determined by a tentative formula which takes account of the width of the trace on the electrogram and also of the density of the air. It was found that when the gradient exceeded about 100 volts per centimetre, the trace was marked by sparking, but this occurred in only a few of the ascents. In 1925 Wilson put forward the hypothesis that, when a lightning flash is about to occur, the electric field just below a thundercloud is probably nearly 10,000 volts per centimetre, a hundred times the strength near the ground. The hypothesis seemed to be supported by estimates of the space charge produced by point discharge from trees and other objects. The soundings indicate, however, that generally there is little if any increase in the gradient as the cloud is approached. It may be that the estimates are systematically in error, and it is to be hoped that control measurements will be made by some more direct method.

One reason for suspecting such systematic error is that the estimated gradients imply that the charges in the clouds are comparatively small. If the gradients over two planes a kilometre apart are +100 v./cm. and −100 v./cm. respectively the charge is (by Coulomb's law) only 0·2 coulombs per cubic kilometre. This is insignificant compared with 20 coulombs, the quantity of electricity supposed to be discharged by a lightning flash. In what part of a cloud the lightning originates, and why it occurs, we have yet to discover.

The investigation is being continued at Kew and, although the ascents made during 1937 have not led to any striking new discoveries, it may be that in the course of time a record will be obtained which will provide the missing clue.

F. J. W. WHIPPLE.

Heat Production, Nutrition, and Growth in Man: Some New Views*

By Dr. E. P. Poulton

INDIRECT AND DIRECT CALORIMETRY

IN estimating the heat production of an individual, the oxygen intake and the carbon dioxide output are measured. After allowing for protein metabolism the oxygen intake is converted into calories of heat generated, by multiplying it with a factor which depends on the respiratory quotient (volume of carbon dioxide produced/volume of oxygen absorbed). These multiplying factors were calculated originally by Zuntz and Schumburg (1901), and are based upon: (*a*) the heats of combustion of carbohydrate and fat; (*b*) the chemical composition of carbohydrate and fat; and (*c*) the theory that when the respiratory quotient has the value unity carbohydrate alone is oxidized in the body and when the respiratory quotient has a value equal to 0·707 fat only is being oxidized, and at intermediate values of the respiratory quotient corresponding proportions of carbohydrate and fat are being oxidized. This method of calculating the heat produced by an individual is known as

* Substance of the presidential address delivered to Section I (Physiology) of the British Association at Nottingham on September 2, revised and modified.

indirect calorimetry. The basal metabolism or basal metabolic rate of American authors or 'standard' metabolism of Krogh and Lindhard is at present defined as heat production in the morning before breakfast, fourteen to sixteen hours after the last meal of the previous day (the post-absorptive condition) with the subject lying at rest.

The heat output of man and animals, under basal conditions, has been measured directly in a calorimeter by Benedict and Carpenter, DuBois and his colleagues and Murlin and Lusk, and compared with the heat output calculated indirectly by means of the Zuntz-Schumburg figures from the oxygen intake and the carbon dioxide output, which were measured simultaneously. The results obtained have been held by their authors to justify the conclusion from average values that the agreement between the two methods was sufficiently satisfactory to give support to the theory of the 'variable combustion ratio' outlined above. However, this theory has not escaped criticism.

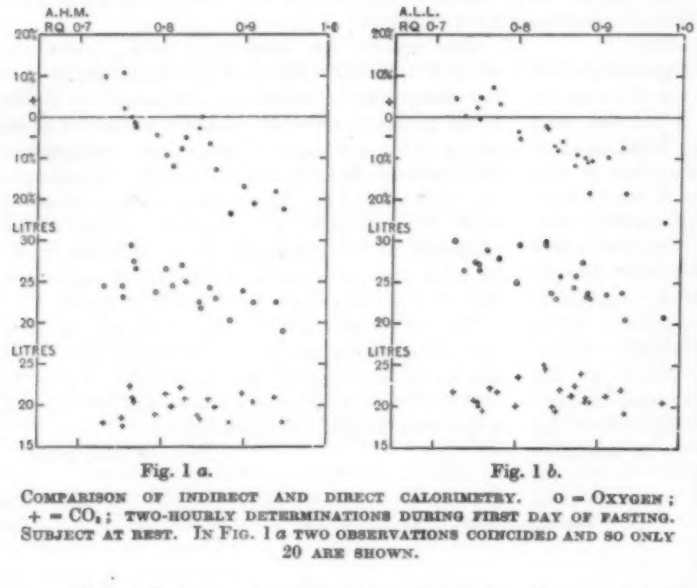

Fig. 1 *a*. Fig. 1 *b*.

COMPARISON OF INDIRECT AND DIRECT CALORIMETRY. O = OXYGEN; + = CO_2; TWO-HOURLY DETERMINATIONS DURING FIRST DAY OF FASTING. SUBJECT AT REST. IN FIG. 1 *a* TWO OBSERVATIONS COINCIDED AND SO ONLY 20 ARE SHOWN.

AN APPARENT ERROR IN INDIRECT CALORIMETRY

The most complete study of direct and indirect calorimetry in normal man under basal conditions is that made by Benedict and Carpenter. Using the data for two subjects, the theoretical heat from the oxygen intake and the respiratory quotient was calculated by the Zuntz-Schumburg method, and this heat (indirect heat) was compared with the heat actually measured by the calorimeter (direct heat). The difference between the indirect and direct heat was expressed as a percentage of the direct heat and related to the respiratory quotient by a graphic method. The result is shown in Figs. 1 *a* and 1 *b*. The horizontal line at zero in the top part of the diagrams represents the condition where the indirect and direct heats are identical; the ordinates represent the percentage differences between the indirect and direct heats. Satisfactory agreement between the heat calculated and the direct heat will depend on the percentage differences, indicated by the black dots, being evenly distributed above and below the horizontal zero line throughout the range of respiratory quotients. This is obviously not the case. The positions of the points suggest a systematic error; for the lower quotients the indirect heat is too high and for the higher quotients too low. DuBois' results tend to show the same thing, though not in such a striking way.

Another way of studying this question is to plot the carbon dioxide and oxygen independently against the heat (Fig. 2). The position of the points in the diagrams shows that there is a linear relation between the carbon dioxide and calories (correlation coefficient 0·950 ± 0·005) and between oxygen and calories (correlation coefficient 0·92 ± 0·008). The carbohydrate line is the relation of the carbon dioxide output and oxygen intake to the heat produced, when pure carbohydrate is burnt in a calorimeter; they were calculated from the value given by Lusk, namely, 5·047 Cal. per litre of oxygen and carbon dioxide. The lines *K* and *M* represent the relation of the heat to the carbon dioxide output on the left-hand side and to the oxygen intake on the right when two different kinds of human fat are burnt. These two fats, from liver and skeletal muscle analysed by Cathcart and Cuthbertson, were chosen because they represent extremes, and the lines of the other nine human fats analysed by them lie in between. Most of the carbon dioxide points lie between the theoretical carbohydrate and fat lines, which are widely spaced; but this is certainly not the case with the oxygen points, as the theoretical limits are much narrower. It is possible to look on the carbon dioxide as the product of combustion of a mixture of carbohydrate and fat, but, because the oxygen points lie for the most part outside the theoretical limits, the oxygen intake cannot,

apparently, be entirely used up in combustion, but must in part be concerned in some kind of conversion.

However, work since Nottingham has exposed an error in these diagrams. In many of DuBois' results there was a considerable difference in the rectal temperature at the beginning and end of an experiment which was taken to imply a large physical liberation or storage of heat, depending on the temperature difference, the body weight and average specific heat of the body (0·83). But since the rectal temperature can only be a rough measure of the body temperature as a whole, it follows that when there are large differences between the eliminated heat (actually measured) and the direct calorimetry (the value after correction for heat physically liberated or stored), there must be considerable uncertainty about the results. It has been found on plotting heat against carbon dioxide, according to the quotient, that when the differences are greater or less than 10 per cent of the eliminated heat, many points fall a long way from the mean line; the eliminated heat has apparently been overcorrected. These uncertain results also form a high proportion of those outside the theoretical limits for oxygen and calories in Fig. 2, and they also seem to account for the similarity of the results of Benedict and DuBois, when the latter are calculated so as to form diagrams as in the upper part of Figs. 1 *a* and 1*b*. If all the uncertain results are eliminated the points in Fig. 2 lie nearer to the mean line, and now appear compatible with the theory of the variable combustion ratio. There is thus a discrepancy between the results of DuBois and those of Benedict, for the latter are incompatible with the theory.

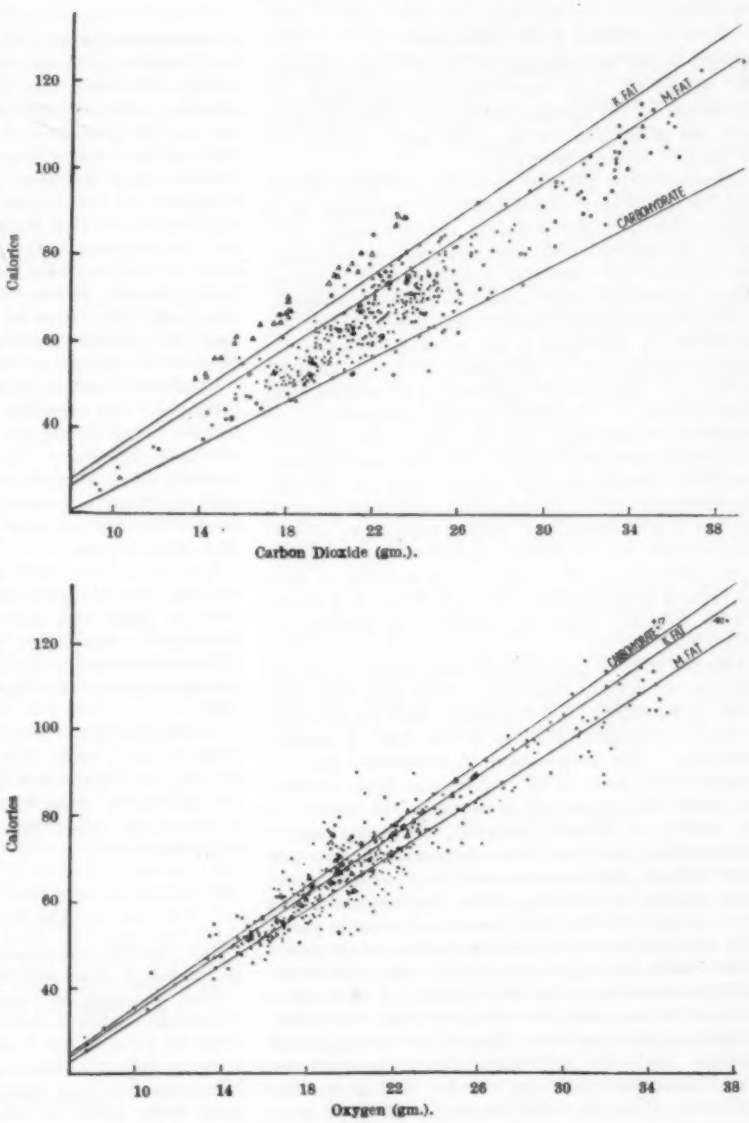

Fig. 2.

COMPARISON OF INDIRECT AND DIRECT CALORIMETRY. DUBOIS' BASAL VALUES (RECTAL TEMPERATURES NOT ABOVE 37·5° C.). ORDINATES: CALORIES PER HOUR; ABSCISSÆ: UPPER DIAGRAM—CO_2 GM. PER HOUR; LOWER DIAGRAM O_2 GM. PER HOUR. ○ TWO COINCIDENT VALUES. △ ALCOHOL CONTROL EXPERIMENTS.

[*To be continued.*]

Obituary Notices

Prof. J. B. Senderens

THE death on September 26 of Jean Baptiste Senderens, who was born in the village of Barbachen in the Hautes-Pyrénées in 1856, removes from our midst one of the most active workers in the field of contact catalysis.

Together with Sabatier in 1899, Senderens found that finely divided nickel could be employed as a catalyst for the hydrogenation of the vapours of a variety of organic substances, and with this discovery the intrusion of catalytic methods into technical organic chemistry may be said to have commenced. In fact, the first patent for the reduction of an organic substance by hydrogen in the presence of catalytic metals was granted to Senderens (*D.R.P.*, 139, 457, of July 26, 1901) for the production of aniline from nitrobenzene. It is possible that the achievements of Senderens would have left an even deeper imprint on modern chemical industry if he had not confined himself to reactions in the vapour phase and left the treatment of liquids, for example, modern fat hardening, coal and liquid tar hydrogenation, to others. Nevertheless, his technical contributions, especially in the field of fine chemicals, and in association with the firm of Poulenc Frères, are important and varied enough to leave industry permanently indebted to him.

One has only to glance at any text-book on contact catalysis to obtain some idea of the wide diversity of the applications that Senderens made of this new method of contact catalysis in the field of organic chemistry. The preparation of substances such as ketones from acids or of cyclohexane from benzene are indeed too numerous to mention. In respect to the theory of contact catalysis, Senderens was a protagonist of the view that intermediate compounds were formed between reactant and substrate—in more modern terminology, that chemisorption was a pre-requisite for chemical reaction. It may be noted that, in addition to the purely preparational character of his work, he made a number of very significant observations which must eventually find their place when we are in possession of the detailed mechanism of these surface reactions. Thus he noted that whilst benzene could be hydrogenated to cyclohexane, dehydrogenation could be effected at higher temperatures. Thus equilibrium can be obtained from both ends and permits of the accurate evaluation of the free energy changes involved in organic reactions. His work on this reaction renders Senderens a pioneer in what is now an important field of physical chemistry.

Again, Senderens observed that acetylene could be hydrogenated to ethane without the addition of hydrogen, the latter being supplied by simultaneous dehydrogenation of part of the acetylene; this reaction may be regarded as the prototype of important reactions involved in the oil industry, where the fundamental processes consist in the catalytic making and breaking of carbon-carbon and carbon-hydrogen bonds. He noted that nickel was a 'better' hydrogenating catalyst than copper; thus carbon dioxide can readily be converted to methane on the former but only to carbon monoxide on the latter metal; likewise amyl acetylene is converted to heptane on nickel but only to amyl ethylene on copper. Similarly, he pointed out that whilst an active nickel catalyst will hydrogenate both cresol and phenol, a nickel catalyst that had been employed for a long period in hydrogenating phenol was rendered inert for the cresol reaction. Here we are evidently dealing with cases of specificity, one of the most fascinating and mysterious features of contact catalysis.

Senderens' work was not confined to hydrogenation processes; he examined numerous cases of dehydrations, that of alcohol to ether or ethylene being the most important. Finally, we may mention that he initiated investigations in the much more difficult field of catalytic oxidations; for example, isoamyl alcohol to aldehyde and the preparation of benzoic acid from toluene.

Senderens, like several well-known French scientific workers, was a faithful son of the Church, becoming first an Abbé and later a Canon. Together with Sabatier he was made an honorary fellow of the Chemical Society in March 1920, and he was elected *correspondant* of the Paris Academy of Sciences in 1922.

In Grignard's "Traité de Chimie Organique" (Vol. 3, 941; 1936) there is written: "La catalyse n'a pris de l'importance en chimie organique que par les travaux de Sabatier et Senderens" (1897–1905), a statement which cannot fail to find universal acceptance.

E. K. RIDEAL.

Dr. R. O. Hall

WE regret to announce the death on November 28, as the result of an accident, of Robert Oswald Hall.

Hall was born on June 24, 1905, and educated at Wakefield Grammar School from 1916 until 1923. In 1924 he entered the University of Leeds, where he took the honours chemistry course, holding the Lord Kitchener National Memorial scholarship from 1925 until 1929. Later, he took part in a general study of the hygienic properties of clothing, and investigated the laws governing the transmission of water vapour through textile fabrics as a function of their structure and the nature of the component fibres. An account of the work is to be found in the thesis on "The Ventilating Properties of Textile Materials and Fabrics", for which he was awarded the degree of Ph.D. of the University of Leeds in 1930. In the same year, he was elected an associate of the Institute of Chemistry, and was appointed an assistant chemist in the Government Laboratory.

In 1931, Hall was appointed research fellow of the Textile Department, Ontario Research Foundation, Toronto, where he remained for three years. There he carried on a series of investigations relating to the quality and specifications of textile materials as used in the motor car industry. This work led him into a number of separate lines of research of a fundamental character. Thus, in regard to the colour of fabrics, he devised an instrument by which it was possible to determine the fugitivity of dyestuffs under controlled conditions of temperature and moisture but under intense illumination, which greatly accelerated the fading. He was appointed to draw up standards of fastness acceptable to the two branches of industry concerned.

Other aspects of Hall's work were concerned with standards of length measurement in relation to the atmospheric humidity and hence the moisture content of textile materials. In addition to such problems as these, which were undertaken on account of their immediate importance to industry, he found time to pursue inquiries of a more academic character, particularly an investigation of the absorptive behaviour of the wool fibre in relation to the degree of swelling.

Early in 1934, Hall accepted an offer of the position of research chemist with Messrs. C. W. Martin and Sons, Ltd., Bermondsey, London, S.E.1, in connexion with their processes in dressing and dyeing fur skins.

During the past three years, Dr. Hall carried out fundamental research on the behaviour, under different conditions, of the individual fibres constituting the fur and pelt of skins. For these investigations he worked out a special technique in microscopy which led to some extremely novel and interesting results. Other problems investigated by him included 'singeing' of hairs, bleaching of ermine, and unhairing of fur seals. His abilities as a physicist proved of great value in work connected with the conditioning and drying of skins.

Hall represented the best type of scientific worker, logical, clear-thinking and of wide experience; by reason of these qualities his views commanded respect and attention. His loss will be felt not only by scientific workers who had come in touch with him but also by his colleagues and friends, who were attracted by his cheerful disposition and sound judgment. He leaves a widow and one child.

Prof. J. S. Štěrba-Böhm

By the death of Prof J. S. Štěrba-Böhm, professor of inorganic and pharmaceutical chemistry in the Charles University of Prague, on January 1 at the age of sixty-three years, Czechoslavakia has lost a distinguished investigator of international reputation. After graduating in pharmacy, Štěrba-Böhm left Prague and travelled through Austria to Serbia, and to Italy, France and Germany. In Paris he was fortunate enough to attract the attention of both Becquerel and Moissan, with whom he carried out some original work.

On returning to Prague, Štěrba-Böhm assisted Brauner in some of his investigations on the rare earths, and this work he continued after the latter's retirement. Meanwhile, an opportunity arose in 1913 and Štěrba-Böhm was appointed assistant professor. After the Great War, in 1919, a chair for pharmaceutical and inorganic chemistry was established for him. He had considerable routine work in connexion with pharmaceutical matters and in 1928–29 was dean of the Faculty of Science, but nevertheless was able to continue his researches and published much original work, mostly in Czech and French journals, on the lesser-known compounds of cerium, scandium and germanium. It was characteristic of him that he took the utmost pains to use the purest materials, a precaution which at first gave his collaborators the impression that progress was unduly slow; but it was one that is most essential in researches on the rare earths. Some years ago he prepared a long list of double oxalates of cerium with meticulous care to ensure the greatest possible purity of the salts obtained. More recently he prepared a number of scandium compounds, in particular the formate and its double compounds. Indeed, he contributed much to the chemistry of this rare metal. With a supply of argyrodite he isolated a whole series of pure germanium salts, bringing up to date the early work of Winkler on this element.

Prof. Štěrba-Böhm was of a retiring disposition but was always willing to put his knowledge at the disposal of his students and colleagues. Like many of his countrymen, he had a command of many languages and was an impressive lecturer. He was honorary foreign member of scientific societies in France, Poland, Jugoslavia and Bulgaria. G. D.

Mr. T. Nelson Dale

T. NELSON DALE, a retired member of the United States Geological Survey, died at his home in Pittsfield, Massachusetts, on November 16, nine days short of his ninety-second year.

Courses in mathematics and mineralogy at the University of Cambridge, petrography under Prof. J. Wolf at Harvard University, field trips under the leadership of Dr. Carl Zittel of the University of Munich to Norway, Sweden, France, Germany and Switzerland, and a stratigraphic and palæontological research problem in the Val de Ledro in the Tyrolese Alps, comprised the systematic part of Mr. Dale's early training. The accuracy of this first geological research, praised by Dr. Zittel and by Dr. A. Bittner of the Austrian Geological Survey, characterized all his later structural and petrographic papers written while he was associated with the United States Geological Survey, from 1880 until 1920. This work was mainly concerned with the Taconic and Green Mountain structural problems, which involved some twelve thousand miles of walking and as much of driving in the most rugged section of western New England. The mapping and the structural sections have

been found to be, on the whole, extremely accurate within the area studied. The latter phase of his work with the United States Geological Survey was concerned with the investigation of the granite, marble and slate industries of New England and the United States, the results of which work, published in the Survey bulletins, have long been considered standard references among quarry men as well as in colleges and universities.

WE regret to announce the following deaths:

Major E. E. Austen, formerly keeper of the Department of Entomology in the British Museum (Natural History), on January 16, aged sixty years.

Mr. Wilfred H. Parker, director of the National Institute of Agricultural Botany, Cambridge, on January 11, aged forty-nine years.

Prof. Otto Warburg, formerly professor of botany in the Oriental Seminary, Berlin, lately chief of the Institute of Natural History of Palestine in the Hebrew University, Jerusalem, on January 10, aged seventy-eight years.

WE are glad to state that the announcement, printed in NATURE of January 15 (p. 109), recording the death of Prof. Otto H. Warburg, For.Mem.R.S., is incorrect. Prof. Warburg had been confused in press messages with Prof. Otto Warburg, whose death is announced above.

News and Views

A World Association for Science and Society

AT a time when restrictions are being placed upon freedom of scientific work and speech in some countries, and when the nations look to science for the materials of destruction, the momentous pronouncement of the American Association at Indianapolis is a challenge to science and to society (see p. 169 of this issue). No men of science who, in the words of the corporate resolution passed by the Council of the American Association, "regard the suppression of independent thought and of its free expression as a major crime against civilization itself", can ignore that challenge. Nor is the British Association likely to disregard the invitation to co-operate in forming the nucleus of what will be a World Association for the Advancement of Science and Society—an international 'brains trust'—since it was the success of the Blackpool meeting and its concern for social problems which inspired the recent action in the United States. What the American visitors heard there, in the free and constructive addresses delivered by scientific workers on the effects of science on social problems, convinced them that men of science, with unsealed lips, had a great contribution to make to world order. The symposium on "Science and Society", at their Indianapolis meeting, was their first response. The resolutions of their council, proclaiming a Magna Charta of scientific freedom, reaffirming the democracy of knowledge, and inviting all who could subscribe to the free principles of science to join in world co-operation, carried the lesson of the British Association into world affairs.

THE language of the resolutions is forthright and uncompromising. It will not tolerate intolerance. It demands a free trade in scientific knowledge and the recognition that the object of science is the advancement of the well-being of all mankind. As the *New York Times* said in the leading article endorsing the proposals which Mr. Ritchie Calder made in the *Daily Herald* for a Magna Charta and an Anglo-American nucleus, and which led to the American Association taking it up: "He has not exaggerated. To save science his 'World Association' is needed, an organization which shall indicate how the objective attitude of the laboratory may be applied in governing a people, in breaking down prejudices, in preventing war, in solving problems that mean progress not in one country alone but the world over." It is an ambitious project, but the ideals it propounds are those of science itself. Objectivity in a world of misrepresentation and dangerous prejudices is sorely needed. The social inquiries of the League of Nations' Technical Commission on Nutrition, and its parent body the Mixed Commission of the League, are examples of how the principles of science may be universally applied.

WHILE, however, it is important to provide a platform from which men of science throughout the world can proclaim the truths of science, it is also important that a World Association, to fulfil its objectives, must have the means to initiate inquiries, collect data and be prepared to co-operate with the social forces for peace and progress. In all the vicissitudes of the political history of the League of Nations, the International Labour Office and the Health Organisation have carried on their constructive humanitarian work. A similar organization for science, more effective and far-reaching than the Committee for Intellectual Co-operation, would give substance to the spirit of the American proposals. It would be a World Association, safeguarding the independence of scientific workers and of scientific thought, willing to co-operate with all nations which are prepared to work for the good of mankind, but, as an association, subject to none.

Prohibition of NATURE in Germany

THE declaration of scientific freedom made by the American Association in the resolutions referred to above is a gratifying sign that men of science remain true to the essential condition of scientific progress. That it should be necessary to reassert a principle for which science—as a pursuit for truth—has always stood, is a depressing commentary upon twentieth century events. Until recent years it was believed that the battle for freedom of scientific thought and work had been fought and won, but we are now often painfully reminded of reactionary tendencies. An example of this is afforded by the following translation of an order issued by the German Ministry of Education (Reichserziehungs-Ministerium) a couple of months ago, a copy of which has just reached us: "In the scientific weekly journal NATURE, articles have often been published containing unprecedented and base (*unerhörte und niedrige*) attacks against German science and the Nationalsocialistic State. Therefore this journal must be excluded from general use in scientific libraries. I request that appropriate orders be given to the libraries of the Universities, Colleges, Institutes, and Research Departments. Concerning the secret use and restricted access to the journal I refer to my decrees of the 17th September 1934, 3rd April 1935, and 16th December 1936:—U I 22733, W I e 828, and—W I a 2305."

IT is, of course, altogether untrue to assert that NATURE has ever attacked German contributions to scientific knowledge. Never a week passes without the publication in our columns of appreciative reviews of German scientific works and summaries of papers published in German scientific periodicals, while we are glad also frequently to print original contributions in our correspondence columns. We welcome the opportunity of recording worthy additions to the literature of science or to natural knowledge from any country or any race; but we should be false to the traditions of science if we failed to condemn any influence which would make scientific research subservient to political or theological domination. The misrepresentation of our attitude contained in the announcement of the German Minister of Education is hard to bear, but we regret that the penalty involved in the withdrawal of NATURE from libraries and other institutions will be felt more by some of our readers in Germany than by ourselves.

Science for Peace

A RECEPTION was recently given, jointly by the League of Nations Union and the International Peace Campaign, in honour of the Nobel peace prize award to Lord Cecil. Science was officially represented by Prof. Jean Perrin, who spoke as Under-Secretary of State for Scientific Research to the French Government. A number of well-known British men of science, including Sir William Bragg, were also present. Afterwards Prof. Perrin spoke informally to a small group of scientific workers about the work of the Science Committee of the I.P.C. in France. This Committee, which comprises some seventy men of science, among whom are many of the most eminent in France, has concerned itself with the special relations of science to the problems of peace and war. As Prof. Perrin himself put it, in his Armistice Day address at the Sorbonne: "It must be stressed that we scientists, even more than other men, desire peace, because the very fact of our specialization enables us to realize more vividly what we have to lose from war. Let me make myself clear. Other men defend the happiness of mankind, as they know it; we do so too, and this is certainly enough to justify our effort and our enthusiasm. But apart from this we, who because of our profession can see a little further, are also defending the future of mankind. We are defending the city of the future, that city the form of which is as yet uncertain, where progress will be indefinitely maintained, where justice and fraternity will rule without conscious effort, where illness will have disappeared and death have receded, until it becomes a freely accepted rest, and where each human life will unfold in harmony and beauty. I hope that you will see in this a reason for organizing that peace without which we shall never reach the magnificent realization of that which appears to contemporary man to be the highest ideal."

Indian Science Congress at Calcutta

OUR correspondent, writing from Calcutta on January 9, says: "The Indian Science Congress at Calcutta draws to a triumphant conclusion. The founders of the Congress Association must view with pride the successful outcome of their venture, and the founders of the British Association might well have been proud also, for their work has its continuation not only in the British but also in the Indian and other associations over-seas. The opening of the Congress on January 3 by H.E. the Viceroy was a brilliant occasion. It is understood that membership of the Congress has far exceeded that of any previous meeting, and at the popular lectures given by Prof. H. J. Fleure, Dr. F. W. Aston, Sir James Jeans, Sir Arthur Eddington, and Prof. F. A. E. Crew, the attendances have been enormous: for at least one of them, that by Sir James Jeans, the hall was almost stormed. Very generous hospitality has been afforded by Government authorities, the University and the Corporation of Calcutta, many institutions and private hosts. The time of the delegation has been very fully occupied, not only with the proceedings of the Congress but also in making or remaking those personal contacts for which such an occasion as this offers almost the sole opportunity. A considerable number of the delegates will now proceed from Calcutta to various points in India in pursuance of personal scientific interests and engagements. A party of about fifty, however, are about to leave for six days' travel in the south, during which time they will be formally received by the University of Madras and by the Government of Mysore and the University of Bangalore. They will join the R.M.S. *Strathaird* at Bombay on January 15

for the homeward voyage. The extraordinary good fortune of the delegation in the matter of weather conditions, culminating in the brilliant hours of the visit to Darjeeling, has been recorded in a previous note. At Calcutta these conditions have continued, and it is said that the mean daily temperature has been as much as ten degrees above the normal for this time of year."

Broadcasting and Citizenship

AT the North of England Education Conference on January 6 the Central Council for School Broadcasting and the Central Committee for Group Listening were represented by their secretary, Mr. A. C. Cameron, who discussed the principles on which these two bodies are at present shaping their policies and raised a number of questions as to the moulding and educating influences of broadcasting on the citizen of to-morrow and to-day. As regards school broadcasting, for the reception of which, by the way, in England and Wales some 7,000 schools are equipped, he emphasized its importance as fostering the interest of the child in life outside the school and the interest of the parent in the school. As evidence of the growing interest of parents he mentioned that a school broadcast recently brought him three hundred letters from parents who had listened to it. To promote group listening and discussion seven area councils representative of voluntary bodies, local authorities and the universities have been constituted. Many listening and discussion groups have been formed by such bodies as women's institutes, townswomen's Guilds and public libraries, and many are recognized by local education authorities as eligible for grants for "further education". Another speaker at the Conference, a member of the executive of the National Union of Teachers, argued that wireless receiving sets ought to be regarded as essential pieces of equipment for schools and for bodies such as juvenile organization committees and community centres which undertake to promote group listening as a means of adolescent and adult education. It seems open to question whether grants should be made for encouraging such listening and discussion groups without some sort of guarantee that they are conducted by competent leaders. With proper guidance (for which attendance at university extension tutorial classes would provide an excellent training) such groups could be developed into a powerful agency for education for citizenship.

Psychology of International Relations

IN an address at a public luncheon given by the National Institute of Industrial Psychology on January 13, Dr. William Brown said that the psychology of international relations, otherwise the psychology of peace and war, can be adequately discussed only on the basis of a scientific study of the human mind. Dr. Brown is convinced that the latest war was not the last. He compared it with a manic-depressive patient who, after a state of deep depression, passes into one of exaltation and feels that never again will his old symptoms return. Of a patient of this kind it is known that sooner or later he will have another relapse. Although psychological treatment can benefit such a patient, and in some cases produce recovery, the underlying physical and mental causes of the illness remain obscure. So it is with war and peace. Psychologists cannot yet claim that a solution has been discovered. All they can do is to go on and disentangle the various forces which are at work to produce war. Of these forces, one of the most important is the primitive struggle for existence. It is not possible, however, said Dr. Brown, to deduce the social behaviour of a man from his purely individual behaviour. Man still carries with him tendencies towards more primitive forms of mental reaction such as are appropriate to the early stages of national and social evolution. These primitive forms of reaction are very clearly revealed in criminal behaviour, in panic-stricken flight and in certain mass movements. The possibility of mass mental reactions have an obvious bearing upon the problem of war and peace. For such primitive forces as self-preservation and self-assertion, while valuable in many respects, yet if used in certain ways, are irreconcilable with ultimate peace between individuals or between nations.

Chinese Universities Relief Fund

THE damage inflicted on universities in the course of the Japanese invasion has been enormous, amounting in several instances to complete destruction of all the university buildings and equipment. Concerted action has been taken by students, professors and the Chinese Government to combine the relief of distressed students with the maintenance of some form of training in centres remote from the war theatres, such as Changsha in Hunan Province. Appeals to universities in other lands have been organized by International Student Service for the relief of destitute students and for equipping them in their efforts to carry on their studies. In England there has been a response from every single university and the majority of university colleges, the amount raised in this way up to date being £3,000. The English committee has undertaken, in addition to contributing to the international fund, to assist Chinese students in Great Britain whose funds have been cut off. In a letter to *The Times* of January 7, Sir Walter Moberly, chairman of the International Student Service, appeals for at least another £2,000. Contributions may be sent to Prof. Ernest Barker, the Hon. Treasurer of the Chinese Universities Relief Fund, at 49 Gordon Square, London, W.C.1.

Determination of Molecular and Atomic Weights

A COMMITTEE for the study of the determination of molecular and atomic weights of gases by physico-chemical methods, organized by the International Institute of Intellectual Co-operation assisted by the International Council of Scientific Unions and by the International Unions of Physics and Chemistry, met on December 17 and 18 in Neuchâtel (Switzerland). Two reports formed the basis of the discussion, the first on the method of limiting-pressures, established

by Prof. R. W. Whytlaw-Gray and Dr. W. Cawood, the second on the method of limiting-densities, established by Prof. E. Moles. Prof. Jaquerod presided over the assembly, which was attended by Profs. Whytlaw-Gray (Leeds), Moles (Madrid), Lepape (Paris), Klemenc (Vienna), Timmermans (Brussels), Keesom (Leyden) and Dr. Cawood (Leeds). Several suggestions were made concerning the improvement of the methods used, and a discussion took place concerning the interpretation of the results obtained. Among the conclusions, the committee emphasized the international importance of the laboratories at Leeds (Whytlaw-Gray) and at Madrid (Moles), on account of the results they obtain, their equipment and the special qualifications of their staffs. This is to be reported to the International Organisation on Intellectual Co-operation of the League of Nations. The full reports and the minutes of the meeting will be published by the International Institute of Intellectual Co-operation. This meeting was a part of the projected scientific activity of the International Organisation on Intellectual Co-operation. Future assemblies of committees of study will be held this year and the following questions will be discussed: "New Vitamins"; "Nomenclature of Genetics"; "New Theories of Modern Physics"; "Co-ordination of Scientific Terminologies" and "The Electric Double Layer".

Scottish Universities Parliamentary Election

On January 20, a writ was issued for the Scottish Universities by-election, made necessary by the death of Mr. Ramsay MacDonald. A group of strong candidates is in the field: Sir John Anderson, former Governor of Bengal, the nominee of the Unionist Associations of the Universities; Prof. A. Dewar Gibb, regius professor of law in the University of Glasgow, a Scottish Nationalist; Dr. Frances H. Melville, formerly mistress of Queen Margaret College, University of Glasgow, an Independent candidate; and Sir Peter Chalmers Mitchell, biologist and former secretary of the Zoological Society of London, standing as an Independent Progressive. Sir Peter Chalmers Mitchell is a graduate of the University of Aberdeen as well as of the University of Oxford, and he has maintained contact, during a life devoted to biological science and administration, with the arts and with educational developments in Great Britain and abroad. He was secretary of the Zoological Society of London for thirty-two years, and for a long period was leader writer and scientific correspondent of *The Times*. At a meeting of Scottish graduates in London he stated that the principle of university seats in Parliament is most difficult to defend if these are simply to be held by official nominees of the political parties, and that he considers it the duty of university electors to select the candidate with the best qualifications to advocate the services which the arts and sciences can give the nation. Sir Peter is particularly well qualified to present and uphold in the House of Commons the scientific outlook upon modern problems touched by science, and on this account his election to Parliament would be widely welcomed.

Centenary of James Craig Watson

On January 28 the centenary occurs of the birth of the American astronomer James Craig Watson, whose name is recalled by the Watson Medal of the National Academy of Sciences. He was born in Elgin County, Canada, of American parents, and at the age of fifteen years he entered the University of Michigan at Ann Arbor, and there came under the influence of the German astronomer Franz Brünnow (1821–91) who in 1854 had been appointed the first director of the Ann Arbor Observatory. Watson soon became an enthusiastic astronomer and on Brünnow's resignation in 1863 he succeeded him as director of the Observatory and as professor of astronomy. He held these positions until 1879, when he was appointed director of the Washburn Observatory at the University of Wisconsin, Madison, where he died suddenly on November 22, 1880, at the early age of forty-two years. Watson became known by his discovery of the minor planet Eurynome, which he first observed in 1863. Afterwards he discovered twenty-one other similar bodies. In 1867 he published a valuable work on theoretical astronomy which became a standard text-book. He was one of those who journeyed to Sicily to observe the solar eclipse of December 22, 1870, and four years later he visited Peking to observe the transit of Venus, for which event the astronomical world had established some forescore posts of observation at a cost of about a quarter of a million. In 1870, by which year he had discovered seven minor planets, Watson was awarded the Lalande Medal of the Paris Academy of Sciences.

Royal Astronomical Society's Awards

The gold medal of the Royal Astronomical Society has been awarded to Dr. William Hammond Wright, director of the Lick Observatory, Mount Hamilton, California, for his studies of the spectra of gaseous nebulæ and of novæ and for his work on the photography of planets in light of different colours. A bronze ('Jackson-Gwilt') medal and gift have been awarded to Mr. P. M. Ryves for his observations of variable stars and other astronomical work, and also to Mr. F. J. Hargreaves for his contributions to astronomy. The investigations of Dr. W. H. Wright on the spectra of the gaseous nebulæ comprise: (1) measurements of wave-lengths and of intensities of nebular lines; (2) the study of the nebular nuclei; (3) the investigation of the distribution of nebular radiations throughout the nebulæ. Dr. Wright was the first to realize the importance in these observations of accurate guiding, without allowing the object to drift along the slit to lengthen the lines, in order to study the spectra of the nuclei and to derive information with regard to the localization of lines in some of nebulæ. He has recently returned to the study of the spectra of planetary nebulæ in the ultra-violet, taking advantage of the extension to shorter wave-lengths made possible by the coating of the 36-inch mirror of the Crossley reflector with aluminium. Mr. Ryves has for many years been a most assiduous and accurate observer of variable

stars, and has communicated fifteen papers on that subject to the Society. Mr. Hargreaves has rendered important services to astronomy by the design of valuable instrumental accessories. He has devised an electric drive for telescopes which has been very successfully applied to the 28-inch equatorial at Greenwich. He also constructed a "comparison image micrometer" with which he made double-star observations with an accuracy which compared very favourably with that of observations made with the filar micrometer. In addition, he has produced mirrors and other work of high excellence. His contributions to astronomical observation have been chiefly in the delineation of planetary detail, but he has given much attention to astronomical photography.

Geological Society of London Awards

THE council of the Geological Society has made the following awards: Wollaston Medal to Prof. Maurice Lugeon, of the University of Lausanne, in recognition of the value of his researches on the mineral structure of the earth, particularly in respect of the geological structure of the Alps and of mountain building; Murchison Medal to Dr. Henry Howe Bemrose, in recognition of his researches upon the igneous rocks of the Lower Carboniferous of Derbyshire, and also upon the Pleistocene fauna of the same area; Lyell Medal to Dr. John Pringle for his services to palæontological science, and particularly in recognition of his work in connexion with the Geological Survey and Museum; Wollaston Fund to Dr. Henry Francis Harwood, of the Imperial College of Science and Technology, in recognition of his research work on the chemistry of minerals and rocks; Murchison Fund to Dr. Frank Coles Phillips, for his contributions to metamorphism and structural petrology; a moiety of the Lyell Fund to Dr. Sydney Ewart Hollingworth, for his work on the Lower Carboniferous rocks, and the structural geology of the Lake District and northern Pennines, and on the Vale of Eden glaciation; another moiety of the Lyell Fund to Dr. Frederick Murray Trotter, for his geological researches, especially on the glacial and post-glacial phenomena of the Eden Valley.

ε Aurigæ—a Super-giant Star

UNTIL the requisite details are available in the *Astrophysical Journal* regarding Dr. O. Struve's discovery of the precise nature of the eclipsing binary system of ε Aurigæ, no useful comments can here be made. It may be inferred, however, from the Press reports that a study by Dr. Struve of the infra-red spectrum of the star obtained with sufficiently high dispersion has shown that the chief component of the system is a super-giant star with a radius some 3,000 times that of the sun. The star of largest radius hitherto known is Antares, the radius of which is about 450 times the sun's. ε Aurigæ, the light variation of which is of Algol type but with an exceptionally long period of 27·1 years, has long been the subject of intensive observation, mainly in Germany, in the United States and in Canada. The spectroscopic history of the star up to 1928 is summarized in "Handbuch der Astrophysik", 6, Pt. 2, 466 (1928). Results obtained at the Yerkes Observatory by Frost, Struve and Elvey at the last light minimum in 1928–29 are given in the publications of that observatory in vol. 7, Pt. 2. During the same epoch, Adams and Sanford were able to distinguish clearly on their high-dispersion spectra taken at Mount Wilson a faint component on the redward side of the enhanced lines and those of hydrogen. They pointed out the necessity of obtaining high-dispersion spectrograms of ε Aurigæ at other epochs of the period of light variation in order to trace the origin of the faint spectral component.

Recent Advances in Glass Technology

TWENTY-ONE years ago was a strenuous period for British technologists, and in no field were the problems more urgent than in connexion with the production of glass for laboratory, optical and many other purposes; thus the necessity of team-work brought the Society of Glass Technology into existence, and its coming-of-age has recently been celebrated. A series of lectures on "Glass in Modern Life", arranged by the Society in this connexion, recalled some of the veritable struggles of the period of the Great War, and the more ordered progress of this 'key industry' under the subsequent measure of protection accorded to it. Prof. W. E. S. Turner mentioned that the value of the production of the chemical and scientific glassware industries has risen from £129,000 in 1924 to £250,000 in 1937, and is doubtless even higher to-day. Undoubtedly, the activities of the Society have contributed in no small degree to the possibility of this expansion, and the same is true of Prof. Turner himself and the Glass Technology Department at the University of Sheffield. The term 'glass' covers a very wide variety of chemical substances; when we find it being employed in these days (*inter alia*) for nuts and bolts, woven fabrics (of course for highly specialized purposes), and bricks for building, we may wonder whether the golden age of glass production is only just beginning. The list of lecturers also included Mr. Raymond McGrath and Mr. Bernard P. Dudding, who dealt with the applications of glass in their special fields of architecture and illuminating engineering respectively; and Dr. W. M. Hampton contributed a lecture on new developments in the field of optical glass. Although the production of optical glass may be a very minor activity from the business point of view, the experience gained in efforts to improve it has been invaluable in its lessons for the larger-scale operations.

Cave Paintings and Military Operations in Spain

WHILE anxiety was felt generally throughout the world as to the fate which was likely to befall the artistic treasures of Spain until reassurance was given by Sir Frederic Kenyon's visit of inspection to the scene of hostilities, archæologists were no less perturbed at the thought of the damage which might be done to the priceless palæolithic paintings of the caves of northern and eastern Spain, both within the

zones of operations. In the current number of *L'Anthropologie* (47, 5–6) a note is published from the Abbé Breuil to M. R. Verneau, in which it is stated that Prof. H. Obermaier has been informed by a journalist that the famous cave of Altamira, in the neighbourhood of Santander, the best known and most important of the caves, had suffered no serious injury, although it had given shelter to some hundreds of refugees and the house of the guide had been occupied by an officer of the Red staff. Alcade del Rio also is informed that the same is true of the other caves with paintings of the Cantabrian Pyrenees. On the other hand, M. Verneau is told that the greater part of the archæological collection formed by Sen. Perez de Barradas and housed in the Municipal Museum of Madrid, had been broken up. News of the fate of the important paintings in the province of Teruel in eastern Spain will be awaited with no little anxiety.

Palestine Archæological Museum

THE Palestine Archæological Museum in the newly erected buildings at the north-eastern corner of the city of Jerusalem was opened to the public on January 13, the ceremony, which was to have taken place on January 11 in the presence of the High Commissioner, having been cancelled, owing to the murder of Mr. J. L. Starkey on the previous evening, when on his way to Jerusalem in order to be present. The cost of erecting the buildings has been met in part by a gift of two million dollars to the Government of Palestine by the late Mr. John D. Rockefeller. The site of ten acres, of which the buildings occupy one quarter, was provided by the Government. The architect was Mr. Austen St. B. Harrison. The Museum consists of a central rectangular block, flanked on north and south by buildings around open courts. In addition to the exhibition halls, open to the public, which will house the more striking and important exhibits, galleries are provided for the material which will be accessible to students, while in the basements provision has been made for housing archæological material from excavations and other sources, pending its allocation and distribution. Provision is also made for staff accommodation and library, the latter already consisting of ten thousand volumes, and space being reserved for a further thirty thousand. The Museum will cover the pre-, proto- and historic periods, including the Roman, Byzantine and Arab antiquities of Palestine down to A.D. 1700. Among the antiquities now on view are the Galilee skull, the first Neanderthal skull to be found in Palestine, the remarkable collection of prehistoric pottery dating from the Stone Age to the close of the Canaanitish period, and the ivories from the palace of Ahab in Samaria, discovered in the excavations of 1933–35, which are among the most striking objects of æsthetic interest as yet found in Palestine.

Further Exploration of Tell Duweir, Palestine

APPREHENSION has been felt among archæologists lest the further exploration of Tell Duweir, the Biblical Lachish, should have to be abandoned, owing to the murder of Mr. J. L. Starkey, the director of the Marston-Wellcome Archæological Expedition to the Near East, by whom the mound was being excavated. The death of Mr. Starkey is universally regarded as an irreparable loss to Palestinian studies; but the blow would have been even heavier had it not been possible to continue work on this important site, which has already provided so much valuable material bearing on the interpretation of more than one crucial period in the history of the country and its cultural development. This fear has now been allayed by the announcement that the excavation will continue, at any rate for the present. Arrangements have been made by the High Commissioner for it to be carried on under the supervision of Mr. Lankester Harding, who was recently appointed director of antiquities in Transjordania. Mr. Harding was Mr. Starkey's principal assistant in 1932–36. He is, therefore, not only well acquainted with the character of the site and the lie of its stratification, but also—and this is of no little importance—he is thoroughly familiar with the scheme of operations, which Mr. Starkey had plotted out in relation to the importance of the areas to be excavated, so far as this could be gauged in advance.

Indian Universities and Nationalism

THE annual Patna convocation lecture was delivered on November 27 by the vice-chancellor of the parent university of Calcutta, Mr. S. P. Mukherjee. The lecturer, although disclaiming for himself the qualifications of a historian, declared that Indian universities should saturate their alumni with the lessons of Indian history and civilization, and took as his principal theme an interpretation of Indian history coloured to stimulate the "ever-increasing vitality of Indian nationalism" with somewhat bitter references to present "bondage" and "a subject race and the power that wants to hold it in its leading strings". It seems regrettable, though not surprising, that the Indian universities should under the new constitution allow themselves to be used for the purposes of political propaganda. Lord Willingdon recently remarked that Indian politicians used to believe we were not sincere in wanting to help them in their advance towards responsible government but that they trust us now. No such change of heart seems to have been experienced by Mr. Mukherjee.

Earthquake Records at De Bilt

DR. E. VAN EVERDINGEN'S twenty-second report on the work of the seismological station at De Bilt continues, for the year 1934, the useful lists in its predecessors (*K. Nederl. Meteor. Inst.*, No. 108; 1936). The station lies about five miles north-east of Utrecht and is provided with horizontal and vertical Galitzin seismographs in addition to Wiechert and Bosch seismographs. The report contains the times as recorded at De Bilt of the different phases of 487 earthquakes, and in most cases gives also useful details on the position of the epicentre, as determined by the records at different observatories, the places at which the earthquake was felt and the intensity at them when known.

King George VI Sound

ONE of the most important discoveries of Mr. J. Rymill's recent British Graham Land Expedition was the discovery of the remarkable narrow sound which appears to separate Alexander Island from the main Antarctic continent and to extend for some two hundred and fifty miles in a north and south direction. *The Times* announces that this feature, by permission of the King, has been named King George VI Sound. It would appear to make not only a physiographical but also a structural division, since the rocks to the east are volcanic while those to the west, in Alexander Island, are fossiliferous sedimentaries which are probably related to the rocks of the Andean folds of Graham Land in general.

A Large Sunspot

A BRIEF scrutiny of the sun's disk on January 15, made possible at Greenwich in a break of persistent cloud, showed that a big sunspot had appeared. The approximate time of the central meridian passage was January 18·4, the latitude of the spot being 19° N.; its area was estimated to be about 2,500 millionths of the sun's hemisphere. The spot, which resembles the giant spot of last October, will reach the sun's western limb on January 24. A magnetic storm was recorded at Abinger commencing on January 16 at $22{\cdot}6^h$.

Dr. H. L. A. Tarr

DR. H. L. A. TARR, of the Rothamsted Experimental Station, has been appointed to the Sir William Dunn Institute of Pathology, University of Oxford, where he will carry out research on the chemistry of the bacteria responsible for certain human diseases. During the past four years he has been in charge of the investigations on the brood diseases of bees at Rothamsted and accounts of his work have appeared regularly in the various English bee journals and in scientific periodicals. Dr. Tarr went to Rothamsted early in 1934 with a considerable and varied previous experience in bacteriological work. He had been connected with the Department of Dairy Bacteriology at the University of British Columbia and the Departments of Pathology and Industrial and Cellulose Chemistry of McGill University in Canada, and, immediately before taking up his position at Rothamsted, worked for three years under Sir Gowland Hopkins in the Sir William Dunn Institute of Biochemistry, Cambridge.

New Sundials at the Science Museum

Two portable sundials of considerable interest have recently been acquired and placed on exhibition in the Time Measurement Section of the Science Museum. The first is an ivory column or 'pillar' dial dated 1587, designed for use in a latitude of 44° and indicating hours on the old Italian system in which the day-and-night period was divided into 24 equal parts, starting from sunset. The second dial is a 'universal' one, adjustable for use over a wide range of latitudes; it is by Dollond, the well-known eighteenth century London maker, and has been presented to the Museum by Mr. J. Bentley Bennett.

Announcements

THE Right Hon. Neville Chamberlain, M.P., Prime Minister; the Rev. M. E. Aubrey, general secretary of the Baptist Union; and Viscount Nuffield, chairman of Morris Motors, Ltd., have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the Committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for their public services.

DR. P. LEWIS-DALE, chief chemist of the L.M.S. Railway, has retired; he is succeeded by Mr. W. P. Henderson, assistant chief chemist (Horwich). Mr. H. Hayhurst succeeds Mr. Henderson as chief chemist of the research department at Horwich.

DR. C. G. SELIGMAN, emeritus professor of ethnology in the University of London, is leaving in a few days for Yale University, where he will occupy the post of Bishop Museum visiting professor for the second semester of the present academic year. He will lecture on New Guinea, particularly that part (now called Papua) which used to be known as British New Guinea. Dr. Seligman will be at Yale until early in June, and his address will be: Hall of Graduate Studies, Yale University, Newhaven, Conn., U.S.A.

DR. F. M. R. WALSHE has succeeded Dr. Gordon Holmes as editor of *Brain*.

A SHORT course on industrial physiology and medical industrial psychology will be held at the London School of Hygiene, Keppel Street, W.C.1, on February 7–18. It is designed for members of the supervisory staff in industry, but may also be of interest to industrial medical officers. Further information can be obtained from the Secretary of the School.

THE seventh International Congress of Genetics will be held in Edinburgh in 1939, probably on August 23–30. Prof. F. A. E. Crew, Institute of Animal Genetics, University of Edinburgh, Edinburgh, 9, has been appointed general secretary to the Congress and to him all correspondence concerning it should be addressed.

THE Ducheune de Boulogne Academy, which aims at rewarding independent workers in honour of the memory of the celebrated neurologist, has recently awarded its annual prize of 10,000 francs to Dr. Louis Bory for his work on general, experimental and comparative pathology, the chemotherapy of sulphur, and dermato-syphiligraphy. Further information about the prize can be obtained from the Secretary of the Academy, 28 bis rue Saint-Dominique, Centre Marcellin-Berthelot, Paris.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 165.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Monochromator

IT is well known that chromatic polarization can be used for the purpose of obtaining colour-filters. In general, such a filter can be used only for selecting a very broad region of the spectrum.

R. W. Wood[1] showed in 1914 that a thick quartz plate between two polarizing prisms is a suitable means of selecting one of the *D*-lines in the spectrum of sodium. A bright interference band was placed on one of the components and a dark band on the other component. This arrangement proved very useful in the study of resonance radiation.

In connexion with work of this kind, the new 'Polaroid' film invented by E. H. Land offers interesting possibilities. I have constructed a new type of monochromator which is built up of a number of 'Polaroid' films with intermediate quartz plates. In this way a small spectral region can be isolated in a continuous spectrum.

Suppose, for example, that we want monochromatic light of the wave-length λ_0. We then take a number of quartz plates all giving a bright band at λ_0. If the thickness varies from plate to plate as 1 : 2 : 4 : 8, etc., and if the quartz plates are placed with their principal directions making an angle of 45° with the vibration axes of the parallel 'Polaroid' films, the whole spectrum will almost disappear except for some widely separated narrow bright bands. It is not difficult to find an ordinary colour filter which absorbs all these bands except the one at λ_0.

It is easy to calculate the intensity distribution in a spectrum transmitted by such a filter. If the polarization is complete, the intensity $I(\lambda)$ at the wave-length λ is given by :

$$I(\lambda) = \cos^2\frac{\varphi_1}{2}\cos^2\frac{\varphi_2}{2}\cos^2\frac{\varphi_3}{2} \ldots \ldots \cos^2\frac{\varphi_m}{2},$$

where

$$\varphi_m = \frac{2\pi d_m}{\lambda}\,\triangle n\,; \quad \text{etc.}$$

Here d_m is the thickness of the plate m and $\triangle n$ the difference in refractive index for the extraordinary and ordinary rays.

Fig. 1 shows the effect produced by four quartz plates. The calculation has here been made for crossed 'Polaroid' films ($\sin^2\frac{\varphi}{2}$ instead of $\cos^2\frac{\varphi}{2}$). In this case there is a small displacement between the maxima produced by the different plates which does not appear for parallel Polaroid films. The parallel films are therefore to be preferred.

I ordered an instrument of this kind from Steeg and Reuter in Bad Homburg in the beginning of May this year. The instrument was delivered only the other day and has now been tested in the laboratory. The instrument consists of five Polaroid films (delivered by Polaroid Products, Ltd., London) and four quartz plates of the following thicknesses : 5·1808 mm., 2·5904 mm., 1·2952 mm. and 0·6476 mm. On each side is an ordinary colour filter (Jena *R.G.* 2). The filter was intended to give the wave-length of $H\alpha$ (λ 6563).

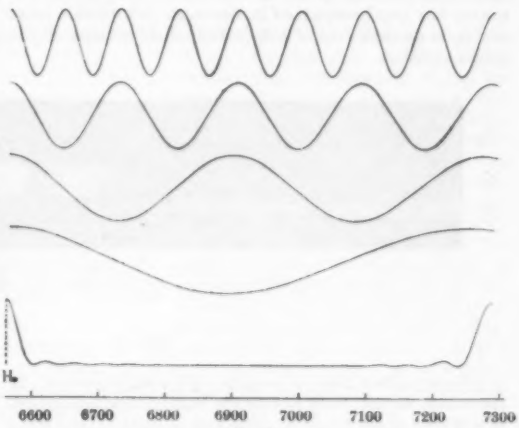

Fig. 1.

The filter has proved to be very good indeed. In Fig. 2 is the spectrum of an ordinary electric lamp and that of neon as comparison, obtained with a one-prism spectrograph. The dispersion around $H\alpha$ is only about 300 A./mm. The left image is a long exposure showing a broad line and one 'satellite' at the side. The right image shows only the central line.

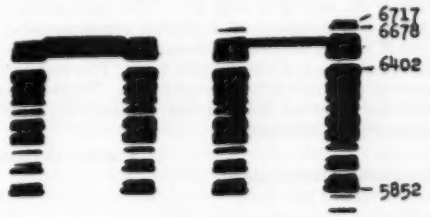

Fig. 2.

Fig. 3 was obtained with a grating spectrograph at the Physical Institute of the University of Stockholm. (I am indebted to Dr. Grundström for valuable help with the exposures.) The dispersion is here 5 A./mm. The central image was obtained by photographing a continuous spectrum with the filter at normal incidence. It shows the intensity maximum

at about λ 6580. In the upper image the filter has been tilted 19°. This image shows stronger 'satellites' and the maximum has been shifted about 100 A. towards the violet.

Fig. 3.

Fig. 4 shows the spectrum obtained when the filter is inclined about 9°. Now the maximum coincides with *Hα*, photographed above. But the monochromator has not been tilted in the most favourable way, which is around one of the principal directions of the quartz plates.

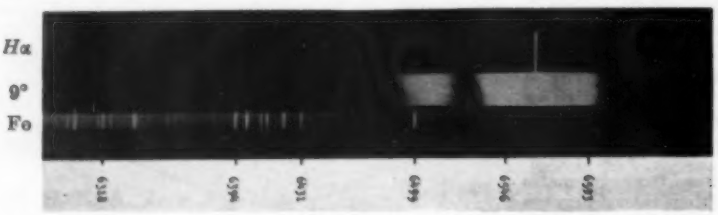

Fig. 4.

The new filter may be used for different purposes. It transmits almost only one single band in the spectrum, of a width of about 50 A. The loss of light is moderate and the definition of the images viewed by it is astonishingly good considering the many layers through which the light has to pass. For many purposes it is an advantage that the transmitted light is polarized. It is an advantage, too, that the wave-length can be adjusted by tilting the filter.

I intended to use this instrument for observing solar prominences. *Observations made to-day have shown prominences without difficulty although the altitude of the sun was only* 10°. The instrument was put after the eyepiece of a 20 cm. refractor and the sun itself was screened by means of thin sheet-metal in the focal plane of the 20 cm. lens. The instrument looks very promising for this purpose. The advantage is that the field of view is not limited by a slit as in ordinary spectroscopes.

YNGVE ÖHMAN.

Stockholm Observatory.
Nov. 26.

[1] *Phys. Z.*, 15, 313 (1914).

Evidence of Abnormal Behaviour of NO_3 in the Cubic Crystal, $Ni(NO_3)_2 \cdot 6NH_3$.

WHEN an excess of concentrated ammonia is gently added to a concentrated solution of nickel nitrate in water, crystals of blue (somewhat violet) octahedra are obtained, the correct composition of which was first determined by Wyckoff[1]. The crystal is cubic; the size of its unit cell and the number of molecules contained in the cell were established by Wyckoff by the Laue method of X-ray analysis. But his proposed structure does not appear to be satisfactory, according to Kracek and his co-workers[2], who concluded that the nitrate group NO_3 might be rotating in the crystal and possess spherical symmetry.

I have taken some powder photographs and a series of oscillation photographs of the crystal, all of which show the crystal to have a face-centred lattice in agreement with Wyckoff's observation. But the oscillation photographs further show that reflections *hkl*, *hlk*, etc. have identical intensities, which implies that the crystal has holohedral Laue symmetry $m3m$ and not paramorphic hemihedry $m3$. The correctness of this observation can scarcely be doubted because two other modifications of the crystal at low temperatures, one at about −100° C. and the other at liquid air boiling point, were also found to have the same Laue symmetry, though their structures are quite different as revealed by the spectra on oscillation photographs of these modifications taken by a low-temperature oscillation camera constructed by me. Consequently the crystal at room temperature must have space group $F\bar{4}3m$, $F43$, or $Fm3m$. But none of the three has a symmetry consistent with that of the nitrate group in the cell if each NO_3 group is assumed to be an entity. Since chemical evidence demands independent NO_3 groups, we are forced to conclude that the behaviour of NO_3 in this crystal must be abnormal.

Different abnormal models were then tested by comparing the calculated intensities of reflections with the observed ones recorded on powder photographs of copper *Kα* radiation, taken by a precision Debye-Sherrer camera of large diameter and measured by a precision micro-photometer. The following structure is found to be most reasonable and able to explain the observed intensities most satisfactorily. The structure is based on space group $F\bar{4}3m$ and has, roughly speaking, the CaF_2 grouping with Ca atoms replaced by $Ni(NH_3)_6$ groups and F atoms by NO_3 groups. Fig. 1 is a diagrammatic representation of one octant of an individual cell of such a structure. The plane triangular NO_3 group is oscillating about a line passing through the average positions of the centres of the two oxygen atoms indicated in the diagram by O_1, with the third oxygen atom O_2 alternating between two extremities which belong to the same equivalent group of the space group as the positions occupied by the two O_1's. The configuration of equivalent NO_3 groups in different unit cells is supposed to be not always the same; its two O_1's may occupy any two of the four equivalent points in the octant, that is, the two points occupied by O_1's and the two ends of the arc described by O_2 in Fig. 1.

As all the possible configurations are equally probable, random distribution of NO_3 among them

gives the loci of the centres of its oxygen atoms a macroscopic average appearance like that shown in Fig. 2. The locus of the N centre appears as if the atom has a big heat motion. It is interesting to note that the theory of space groups and the definition of the unit cell do not strictly apply to this structure.

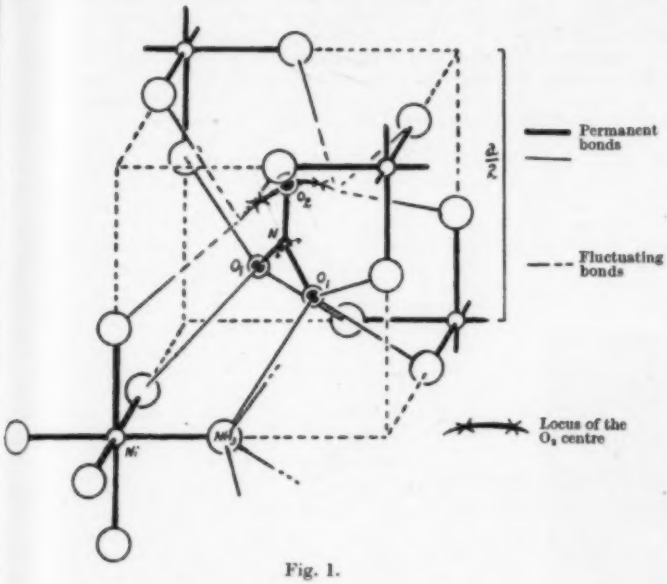

Fig. 1.

To give further evidence of the proposed structure, the signs of the structure amplitudes of the reflections, $F(hkl)$, have been determined in the following way. According to Bradley and Rodgers[3], f-values of the Ni atom for cobalt $K\alpha$ radiation are almost normal, while those for copper $K\alpha$ radiation should be depressed

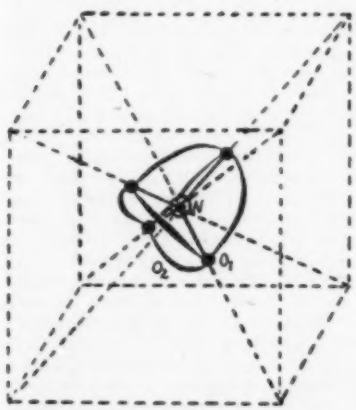

Fig. 2.

by 3 units. In this crystal proper choice of the origin of reference will make contributions of Ni atoms to all reflections positive. If $F(hkl)$ is positive, it should be bigger for cobalt $K\alpha$ than that for copper $K\alpha$ radiation. If $F(hkl)$ is negative, the result should be the reverse. Hence a comparison of the observed intensities of reflections for the two radiations enables us to fix the signs of the $F(hkl)$'s. The result obtained in this way is in complete agreement with the result calculated on the proposed structure.

Another striking feature of this crystal is that the atoms in it have heat agitation of extraordinary magnitude. The rapid decrease of intensities of reflections with the increase of their glancing angles must be due to enormous heat motion of the atoms in the crystal. This is supported by the increase of intensities of reflections of large angle in the low-temperature oscillation photographs. This enormous heat motion of the atoms in the crystal may be correlated with the abnormal oscillation of the nitrate groups mentioned above.

Two other observations may be worth mentioning. When the crystal is cooled down to liquid air temperature, it is found from the oscillation photographs that it contracts into the $-100°$ C. modification, and then expands into the liquid air temperature modification, of which the density is even smaller than that of the room temperature modification. The colour of the crystal exhibits a marked change from blue (somewhat violet) to dark purple and then to brilliant pink during the cooling.

Owing to the preceding abnormalities of the crystal, it might be interesting to study its absorption spectra, as well as its heat capacity at different low temperatures.

Details of the work will appear elsewhere.

I wish to express my sincere thanks to Prof. W. L. Bragg for his interest and valuable advice in this work.

S. H. Yü.

Physical Laboratory,
University, Manchester.
Dec. 4.

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[2] Kracek, F. C., Hendricks, S. B., Posujak, E., NATURE, **128**, 410 (1931).
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The Lorentz Polarization Term and the Earth's Magnetic Field in the Ionosphere

FOR some years, there has been doubt concerning the value of the accelerating force acting on an electron in the ionosphere under the influence of an electric wave. In 1929, Hartree[1] gave reasons for believing that to the field of the wave must be added a resultant field due to the other electrons present, and showed that this could be accounted for by including a term l of value 1/3 in the derivation of the dispersion equations. The equations then became closely analogous to those first deduced by Lorentz for the propagation of light in a body composed of molecules. The term was afterwards included in a great number of published works on wave propagation in the ionosphere.

In 1934, Darwin[2] gave strong theoretical reasons for believing that the value of l in the ionosphere was zero. The settlement of the point is of considerable practical importance, since measured values of electron density in the ionosphere may be in error by 50 per cent if the wrong value of l has been used. Several unsuccessful attempts to find a crucial experimental test[3] have already been made. We have recently obtained what we believe is decisive experimental evidence in favour of the view that l is zero in the F region of the ionosphere. This conclusion has been reached from the study of a number of records similar to those reproduced herewith, which show the radio echoes obtained from the ionosphere at 0045 hours E.A.S.T., on August 28, 1937, over a frequency range of 0·9–1·30 mc./s. In the figure the lowest uniform trace is made by the ground pulse and so indicates ground-level. At the lower frequencies two upper traces are visible, both representing echoes coming from approximately the height at which the F region is normally found. As the

Fig. 1.

EQUIVALENT HEIGHT - FREQUENCY CURVES OBTAINED BY MEANS OF RADIO ECHOES FROM THE IONOSPHERE OVER A RANGE OF FREQUENCIES BELOW THE LARMOR GYRO-FREQUENCY. THE OBLITERATION OF THE RECORD AT 1·07 MC./S. IS CAUSED BY INTERFERENCE FROM A BROADCASTING STATION.

frequency is increased, the lower of these traces rises very gradually, and in fact it is found (though this is not shown in the illustration for reasons of space) that it rises steeply only when the penetration frequency of 6·0 mc./s. is approached. On the other hand, the upper trace is seen in the figure to rise rapidly and is no longer recorded at frequencies greater than 1·27 mc./s. This upper trace exhibits a similar behaviour on all nights when it is observed, invariably disappearing suddenly at frequencies just below 1·30 mc./s. We have arranged for the emitting and receiving systems to have their maximum sensitivities at frequencies just above 1·22 mc./s., but while this has resulted in the recording of a weak echo from the E region at 130 km., and of numerous multiple echoes corresponding to the lower F trace, the 12th of which is seen just below the ground trace after being retarded right round the semi-elliptical time scale, yet we have not been able to record further evidence of the upper echo at frequencies above 1·27 mc./s.

The regular nightly disappearance of this echo just below 1·30 mc./s., although the critical penetration frequency of the F region is much higher and variable, leads us to believe that we are here faced with a phenomenon distinct from that normally associated with the penetration of a region of maximum ionization. We have found an interpretation of the existence and abnormal behaviour of this upper echo from consideration of the dispersion curves of an electron medium in a magnetic field H at frequencies slightly below the Larmor gyro-frequency He/m. Ratcliffe[4] has shown that at such frequencies, for $l=0$, an infinity in μ occurs in the dispersion curve of the ordinary wave, for values of electron density N_1 greater than those (N_3) which give the first reflection point ($\mu = 0$) of the wave. We find that when an appreciable amount of energy of the ordinary wave gets past this first reflection point, it will be largely reflected deeper in the ionized region at the level where the electron density is N_2. A similar conclusion has also recently been reached by a group of workers at Allahabad[5], who show theoretically that the group velocity of a vertically incident ray becomes zero at densities equal to N_2.

From Ratcliffe's work it may easily be deduced that

$$N_2 = m\,(f_1^2 - f^2)/4\,\pi\,e^2\,(f_1^2 \cos\theta - f^2)$$

where $f_1 = H\,e/m$, f is the frequency of the wave, and θ is the complement of the inclination of the earth's magnetic field H. It follows that as f approaches the value $f_1 \cos\theta$, an increasing amount of ionization is required to produce the second echo. When $f = f_1 \cos\theta$, the necessary ionization is infinite. At Sydney the value of f_1 is 1·63 mc./s. at ground-level, and $\cos\theta$, which is independent of level, has the value 0·895. If we suppose that the magnetic field varies inversely as the cube of the distance from the earth's centre, then at a height of 230 km., $f_1 \cos\theta$ is 1·30 mc./s., which is the frequency just below which the upper echo invariably disappears.

It seems clear, therefore, that the upper trace in the accompanying illustration is to be identified as due to this second component of the ordinary wave.

Now, if l be given the value 1/3 in the dispersion equations, no second reflection point of this type is found to occur. The experimental discovery and the identification of the second ordinary echo seems, therefore, definite proof that the Lorentz polarization term l is zero in the F region of the ionosphere.

Theoretical investigation shows that the trace of the second echo should tend asymptotically to infinity on the height scale extremely rapidly, at a frequency f' slightly below $f_1 \cos\theta$. This suggests that if f' can be measured accurately, then a powerful means of measuring the earth's magnetic field in the ionosphere would become available. The small correction $f_1 \cos\theta - f'$ is accurately known in terms of the penetration frequency of the region. The only available method[6] of measuring H in these regions at present is inherently incapable of much accuracy, since it depends on the measurement of a small difference between two large numbers, expressing the penetration frequencies of the ordinary and extraordinary waves respectively.

With the object of making such measurements accurately, we are at present constructing improved equipment in the hope of recording the asymptotic

upward trend of the second echo. This work, which will be more fully described elsewhere, is published by permission of the Radio Research Board of the Commonwealth Council for Scientific and Industrial Research.

D. F. MARTYN.
G. H. MUNRO.

University of Sydney.
Dec. 3.

[1] Hartree, D. R., *Proc. Camb. Phil. Soc.*, **25**, 47 (1929).
[2] Darwin, C. G., *Proc. Roy. Soc.*, A, **146**, 17 (1934).
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New Pallial Sense Organs in Early Fixed Stages of *Ostrea edulis*

A CAREFUL study of sections of newly attached spat of *Ostrea edulis* has revealed the existence of a pair of organs, apparently of a sensory nature, one in each mantle, of a type hitherto undescribed so far as I am aware. These sense organs are not present in the free-swimming larva before attachment, but begin to develop immediately after fixation and are apparently fully developed in the spat three or four days after attachment.

The sense organs are situated on the inside border of the thickened free edge of the mantle, about one third of the length of the free edge from the mouth. In section, each sense organ appears as a thin-walled spherical pigmented sac of epithelium projecting from the inside mantle surface and containing in the cavity a comparatively large concretion which stains vividly with eosin (Fig. 1, *b*). The concretion is not calcareous as it is unaffected by decalcification. Nor does it appear to be siliceous. Each concretion is made up of a large number of small granules, loosely aggregated in the early stages of development, but in older spat closely compacted to form a roughly spherical mass. No cilia can be detected on the inside of the epithelial sac.

The development of these sense organs may be easily followed in sections of recently attached spat. In spat which have been attached for less than 24 hours, a flask-shaped mass of eosinophilous granules may be seen in the epithelium of the outer surface of the mantle, underlying the shell and apparently opening to the exterior. This situation suggests their derivation from one of the unicellular glands which secrete the shell. This view is strengthened by the occurrence of an epithelial nucleus among the granules of secretion. In slightly older spat, up to 48 hours after attachment, this mass of secretion occupies a position between the inner and outer epithelia of the mantle (Fig. 1, *a*). At the same time the inner mantle epithelium becomes raised up into a dome-shaped protuberance and a split appears in the tissues underlying it. The epithelium covering the cavity becomes charged with black pigment granules. The split later enlarges and becomes the cavity of the sense organ. The mass of secretion becomes rounded off, leaving behind a few granules, and sinks into the cavity underlying the dome of epithelium. In later spat the cavity is enlarged and the epithelium covering it is extremely attenuated and densely pigmented. In the cavity there may frequently be seen one or two nuclei which have become isolated during the formation of the sac. In spat which have been attached four to five days, the most advanced among the material available, these nuclei have disappeared and the cavity is occupied only by the rounded mass of secretion. This would appear to be the fully developed condition of these organs. Exceptionally, two masses of concretion have been observed in a single sac.

In endeavouring to assign a function to these organs, it has to be remembered that the larval statocysts persist in the spat of *Ostrea edulis*, an observation first made by Carazzi[1], and now confirmed by me. These statocysts are, however, comparatively deeply seated within the body of the spat oyster and do not appear to be in a position to appreciate small disturbances in the surrounding

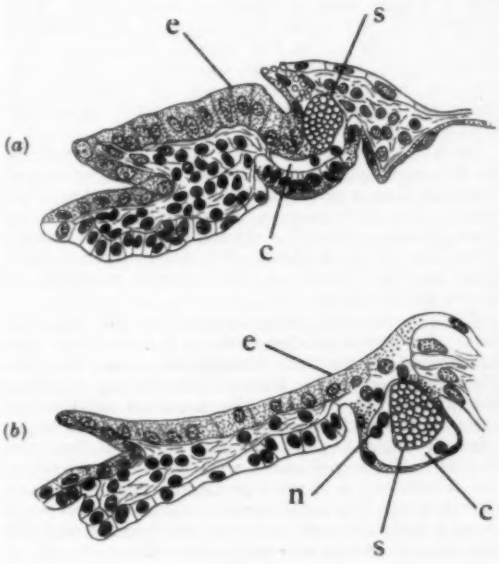

Fig. 1.

TRANSVERSE SECTION OF MANTLE EDGE OF SPAT OF *Ostrea edulis*, TO SHOW THE DEVELOPMENT OF SPECIAL PALLIAL SENSE ORGANS.

(*a*) 24–48 HOURS AFTER ATTACHMENT, SHOWING THE MASS OF SECRETION (*s*) PASSING FROM ITS ORIGINAL LOCATION IN THE OUTER SECRETORY EPITHELIUM (*e*), INTO THE RUDIMENT OF THE CAVITY (*c*) OF THE SENSE ORGAN.

(*b*) 3–4 DAYS AFTER ATTACHMENT, SHOWING THE SENSE ORGAN FULLY FORMED, WITH THE EXCEPTION OF THE ELIMINATION OF THE FEW ISOLATED NUCLEI (*n*). THE SAC COVERED BY THE ATTENUATED INNER EPITHELIUM OF THE MANTLE.

medium. On the other hand, the pallial sense organs here described, situated as they are on the border of the mantle, and separated from the external medium by an attenuated epithelium only, would appear to be suitably constructed and in a favourable position for receiving and reacting to vibrations caused by disturbances in the surrounding water. The value of such organs to a fixed form like the adult oyster is obvious. It would be interesting to know whether such organs exist in other lamellibranchs in which the adult stage is fixed.

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Fisheries Experiment Station,
Conway. Dec. 1.

[1] Carazzi, D., *Intern. Monatschr. Anat. Phys.*, **20** (1902).

Selective Thallium Moult in Sheep

IT is known that sheep may be divided into two large groups according to the structure of their wool. The first group includes cultural races of sheep, the wool of which is homogeneous on the greater part of the body, that is, consists of identical fine curling wool fibres (merino and others). The second group includes a number of country unimproved races of sheep with coarse wool, which consists of fibres of different types, kemp and intermediary (mixed-woolled sheep).

I have already shown the possibility of stimulating in sheep a synchronous shedding of wool by treatment with a single dose of thallium compounds. This phenomenon was given the name of 'experimental thallium moult'[1]. In fine-woolled sheep this phenomenon has already been described[2]. I am now able to report the possibility of obtaining an analogous experimental thallium moult in mixed-woolled sheep.

Since mixed-woolled sheep are characterized by the heterogeneity of their fleece, their experimental moulting may *a priori* be thought of in at least two forms: (*a*) first case—a general shedding of the fleece ('general moult'); (*b*) the shedding of certain types only of wool fibres. We have obtained both these possible forms of experimental moulting in mixed-woolled sheep.

The experimental sheep belonged to the following races of mixed-wool sheep bred in the U.S.S.R.: the fat-rumped sheep of Casakhstan, the Russian-Wallach sheep of the North Caucasus, the chushka-Karakul of the Ukraine, the northern small-tailed sheep of the middle Russia, the fur Romanov sheep (Moscow region), the Armenian sheep, Balbas and Masekh. The experiments were carried out both at the Laboratory in Moscow and under farm conditions (Sovkhozes). The total number of mix-woolled sheep treated with different thallium compounds was 839 and that of untreated control ones 869.

The shedding of certain types of wool fibres while other types of wool fibres remained unchanged was called 'selective or differential experimental moult'.

The course of the general experimental moult in mix-woolled sheep is identical with that in fine-woolled sheep described elsewhere.

The selective experimental moult is a peculiar reaction of the fleece that may be considered morphogenetic. Since fine wool and kemp differ in their structure, they may be expected to differ in their physiological properties as well. We supposed that the differences in the form and the structure of the various types of fibres should be accompanied by functional differences.

Engels'[3] and Spencer's[4] work on the connexion between form and function was the basic hypothesis for our study. These *a priori* theses of dialectical logic led us to study the influence of different doses of thallium acetate upon the heterogeneous fleece.

A number of experiments showed the different heights of the thallium threshold of the fine wool and the kemp fibres. With doses exceeding 12–13 mgm. the fat-rumped mix-woolled sheep shed both their kemp and their fine wool. With doses of 8·5–9·5 mgm. the root strength of kemp remains unchanged, while the fine fibres undergo a diminution of their root strength and consequently fall out. Hence the thallium threshold is approximately 11·5 mgm. for the kemp and about 9·0 mgm. for the fine fibres (stall keeping). This difference in the height of the thresholds for the kemp and the fine wool shedding is the theoretical basis for the realization of the selective moult of fine wool alone.

In a selective moult, the fine wool is always more or less mixed with a certain quantity of intermediate fibres or even of single broken kemp fibres. In the same way the kemp fibres which remain upon the body of the animal contain a certain admixture of fine wool fibres. The wool taken off as a result of a selective moult and containing chiefly fine wool fibres was given the name of 'fine fraction'. The wool which remains on the body of the animal was named 'coarse fraction'.

The effect of the selective moult in fat-rumped mixed-woolled sheep of Casakhstan is as follows: A normal 'original' wool cover proper to this race contains on an average 52·05 per cent of coarse and 47·95 per cent or even 31 per cent of fine wool fibres. The fine fraction contains 12·6–14·9 per cent of coarse and 85·1–87·4 per cent, in some cases 92–95·8 per cent, of fine fibres. The coarse fraction contains 80–93·1 per cent of kemp and 6·9–19·8 per cent of fine fibres.

Similar results are obtained with other races of sheep.

The experiments on selective moulting in sheep which we have carried out may be considered from both the theoretical and the practical points of view.

Selective moulting, as a peculiar morphogenetic reaction, is a proof of the possibility of a *physiological distinction between morphologically different structures* ("Morphologische und physiologische Erscheinungen, Form und Funktion bedingen einander wechselseitig" (Engels[3])).

Hence selective moulting is an excellent subject for the study of the part played by chemical agents in morphogenesis. It may, moreover, be considered as a *method of analysis of living matter* by means of the action of chemicals and pharmacons. These two methods demonstrate the theoretical importance of selective moulting in biology.

Selective moulting has obvious prospects of economically important industrial applications. The country mixed-woolled races are often very valuable because adapted to the climatic conditions and are utilized in many ways (for milk, flesh, fat, etc.). Their wool is of but small value because of its coarseness and heterogeneity. Nevertheless, the fine wool fibres contained in the fleece of sheep with heterogeneous wool does not greatly differ from the wool of fine-woolled sheep. Selective moulting makes it possible to obtain from coarse-woolled sheep with mixed wool, a fine wool approaching or even equalling merino as to wool quality. The only obstacle to a wide application of this method is the presence of certain harmful by-effects, which we shall describe elsewhere.

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Oct. 15.

[1] Iljin, N. A., *Probl. Anim. Husbandry U.S.S.R.*, No. 3, 56 (1932); *Rabbit Breeding U.S.S.R.*, No. 7, 12 (1932).
[2] Iljin, N. A., *J. Genet.*, **33**, 305 (1936); *C.R. Acad. Sciences U.S.S.R.*, **10**, No. 86, 365 (1936). See also NATURE, **139**, 104 (1937).
[3] Engels, F., "Naturdialektik" (Moscow, State Publishing Firm, 1925).
[4] Spencer, H., "Principles of Biology", **2** (1864–1867).

Functions of the Tube in Sabellid Worms

Spirographis spallanzanii Viviani and *Sabella pavonina* Savigny live in tubes made of a mucoid secretion mixed with mud. The animals are negatively thigmotropic, negatively geotropic and positively phototropic. The tubes, after the animals have been removed from them, cannot be stretched, but they can easily be bent. The tubes, however, are completely elastic in that they return at once to their initial shape after bending. In spite of this, the animals can bend their tubes permanently into new curves in the course of their various tropisms. To bend such a tube permanently it would be necessary to soften it; this is probably the function of the external digestion of the tube which I previously described[1]. The innermost lining of the tube is more elastic than the rest, and the new curvatures would be produced by a combination of softening with the deposition of new elastic tube substance within the concave side of the bend.

Removed from their tubes, *Spirographis* and *Sabella* are incapable of making new ones. Tubeless worms can be kept alive indefinitely in aerated sea-water, but in water deficient in oxygen they die, whereas worms with their tubes live in this water. We thus have the apparent paradox that a worm exposed on all sides to the water dies of asphyxia, while a worm whose body is enclosed in a tube can breathe and live.

Sabella and *Spirographis* can be removed from their own tubes and put into glass tubes. They line the glass tube with a secretion, and lengthen it with normal tube material. Such worms in glass tubes will live in conditions of oxygen deficit which kill naked worms. Observation of *Spirographis* in glass tubes has given a probable reason why naked worms are less viable than those in tubes. Inside its tube the worm executes rhythmic movements, which must continually renew the water in contact with the body. At regular intervals a swelling of the body wall, completely filling the tube, forms at the hind end of the worm; this swelling moves forwards. In the case of tubeless worms there are scarcely any such movements, and the animals are probably asphyxiated because of a stagnant layer of water in immediate contact with the body.

Tubeless worms can live in aerated water; presumably they are able to do so in spite of the absence of vigorous body movements because there is more than enough oxygen for them in the water. Worms in their tubes execute the rhythmic movements even in fully aerated water; the result of this must be that the small amount of water in the tube is continually renewed, and presumably it is necessary for the worm to renew this water even when the surrounding sea-water is fully aerated. These observations show that the tube has a second function besides that of protection: it provides the mechanical stimulus for the reflex body movements necessary for respiration.

The metabolism of *Spirographis* removed from its tube falls very considerably. On the same day that worms are taken out of their tubes their oxygen consumption decreases to three quarters, and on the following day to one half, of its previous value, while the ammonia excretion falls on the day of removal from the tube to four fifths of its previous value. This fall in metabolism is probably due in large part to the absence of vigorous rhythmic body movements.

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and University, Birmingham.
Dec. 17.

[1] Fox, H. Munro, *Proc. Roy. Soc.*, B, 112, 479 (1933).

A Curious Case of Supposed Silicon Poisoning in the Swan

DURING March 1936, a swan was received from the Belle Vue Gardens, Manchester, at the Harper Adams Agricultural College, where I was working, with a note that it was one of two or three waterfowl which had all died recently on a particular pond. Post-mortem examination revealed nothing abnormal except an acute enteritis most marked in the duodenum but spreading into the middle third of the intestine. All the other organs were healthy and a bacteriological examination proved negative.

Examination of the bowel contents showed no parasites, protozoan or otherwise, to be present, but large quantities of the water weed *Potamogeton* were found, and amongst them what appeared to be diatomaceous frustules. I became suspicious, and my senior officer, Mr. K. D. Downham, had a chemical analysis made of the intestinal contents. A certain percentage of silicon derived from the gizzard contents is always present in the intestine of birds, but in this case was found to be unusually high. A reference to the files showed that in the previous year, 1935, in the same month, and within four days of the then date, another swan had been received from the Gardens with precisely the same lesions. The Gardens were requested to forward a sample of the water and weed from the particular pond, which when received was found to be full of diatoms. The 'weed' consisted largely of filamentous algæ and blades of *Potamogeton*, encrusted with various species of diatom, notably *Fragillaria* and *Gomphonema*. These were also found free-swimming in the water. A chemical analysis of the water alone revealed an abnormally high percentage of colloidal silicon present. (I may here perhaps mention that the analyses were carried out by the analyst of the Harper Adams College, Mr. Lee).

It was therefore assumed that the enteritis in the swan was the result of mechanical irritation caused by the diatom frustules and the free silicon present in the pond.

Freshwater biologists, particularly Kathleen Carpenter in her "Life in Inland Waters", have pointed out that the spring and late winter are the times of maximum diatom increase. Their frustules cause a rise in the silicon content of fresh waters also in autumn, when *Cladocera* feed upon them but release their valves into the water. Birds would be killed in the spring and not in the autumn, because in spring they are greedy for the greenstuff represented by the weeds and because in addition to the diatoms there is present a large amount of free silicon released during the winter by bacterial action, namely, that which the diatoms themselves utilize in the formation of their valves. In autumn, dead shells float freely through the water, and are simply washed through the gut of water-fowl as they swallow water. I suggest that it was because the diatoms were entangled in the weed that they exerted their supposed irritative action; combined with the action of the water saturated with silicon which permeated and enveloped the algal cells.

Instructions were given that the pond was to be drained, all vegetable matter removed and its floor and sides thoroughly scrubbed and disinfected with Chloros; and no further cases have been reported.

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Use of Sulphur Dioxide against the Bedbug

SULPHUR dioxide, usually obtained by burning sulphur, when used as a fumigant for bug-infested houses, has not always been successful. Schlupp[1], Gunn[2] and others have suggested that the eggs of the bedbug (*Cimex lectularius* L.) were more resistant than adults to sulphur dioxide. Fetscher[3], however, recorded adults surviving at concentrations which killed the eggs.

I have carried out laboratory experiments to determine the relative resistance of different stages of the bedbug to sulphur dioxide. Using a fumigation apparatus similar to that described by Bovingdon[4], I have exposed different stages of the bedbug for 2½ hours to known concentrations of this gas under controlled conditions of temperature and humidity. A summary of these results, expressed as the amount of sulphur dioxide required to give a complete kill of each stage at 23° C. and 60 per cent relative humidity, is given below.

Stage	Concentration of SO_2 (mgm./litre)	Concentration of SO_2 (% by volume approx.)
0–2 day old eggs	16·7	0·63
2–4 " " "	15·8	0·61
4–6 " " "	12·0	0·46
6–8 " " "	8·9	0·34
1st nymphal instar 1 day after hatching, unfed	6·2	0·23
1st nymphal instar 2 days after feeding	6·1	0·23
2nd " " " " " "	6·0	0·23
3rd " " " " " "	5·7	0·22
4th " " " " " "	5·8	0·22
5th " " " " " "	6·1	0·23
Adults, 2 days after first meal	4·2	0·16

It appears, therefore, that the egg, especially just after being laid, is considerably more resistant to sulphur dioxide than either the adult or any nymphal instar, and that this resistance gradually decreases as the time of hatching approaches.

These results are part of an investigation carried out under the direction of Prof. J. W. Munro on behalf of the Committee on Bedbug Infestation of the Medical Research Council.

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[1] Schlupp, W. F., *J. Dept. Agric. S. Africa*, **4**, 132 (1922).
[2] Gunn, W. C., "The Bedbug". Prevention of House Infestation. Dept. Hlth. Scotland, **2** (1933).
[3] Fetscher, R., *Reichsgesundheitblatt*, Nos. 11 and 12 (1927).
[4] Bovingdon, H. H. S., *Ann. Applied Biol.*, **21**, 4 (1934).

Stomatal Movement and Epidermal Water-Content

IN a recent paper, F. J. Nutman[1] has described the behaviour of the stomata of the coffee plant and directed attention to their remarkable sensitiveness to insolation. Within three minutes of exposure to direct sunlight the stomata begin to close, even though the water supply is abundant. Moreover, the closure is reversible: shading a single leaf on an insolated plant results in opening of the stomata of the shaded leaf. This is quite outside the normal range of stomatal behaviour hitherto described.

It seems possible, however, that results obtained in my laboratory by Dr. H. A. Razvi[2] may provide a clue. Following up the observation that the stomata of certain succulents are sensitive to atmospheric humidity, Dr. Razvi discovered that their behaviour, in the leaves of *Kleinia articulata* and *Sedum album*, is not correlated with the water-content of the leaf as a whole, for a turgid leaf in a dry atmosphere will open its stomata less widely than a leaf with a considerable water deficit in a saturated atmosphere.

These observations direct attention to the water content of the *epidermis* as the effective factor. In a dry atmosphere cuticular transpiration, if considerable, would reduce the water-content of the epidermis in relation to the mesophyll. Stomatal transpiration would affect primarily the subepidermal mesophyll and so the epidermis itself. In succulent leaves the vascular organization is not very efficient, and the gradients of water deficit would be correspondingly steep. In a saturated atmosphere, these gradients would be equalized, or possibly the epidermal water-content raised above that of the rest of the leaf by direct absorption, without affecting the total leaf water-content recognizably.

In normal leaves, it is possible that lateral movement of water through the epidermis itself is the main channel of supply to the epidermal cells, direct from the veins. La Rue[3] observed in *Mitchella repens* that the epidermis remains alive and normal even when it becomes entirely separated from the underlying tissues except at the midrib and the margins of the leaf. The wavy outline characteristic of the stomatal epidermis in so many plants must reduce the resistance to lateral passage of water from cell to cell. Freer movement of water through the epidermis would tend towards uniformity of stomatal behaviour.

Since epidermal water-content is the factor directly affecting stomatal movement, and since it may be relatively independent of the water-content of the mesophyll, it is conceivable that insolation of coffee leaves may act by lowering the epidermal water-content although the leaf as a whole remains turgid. The possibility could readily be tested, for the effect should not be observed, or should be reversed, in a saturated atmosphere. Coating the leaf with 'Vaseline' should have a similar effect.

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Bangor.
Dec. 28.

[1] Nutman, F. J., *Ann. Bot.*, (N.S.) **1**, 681 (1937).
[2] Razvi, H. A., Ph.D. thesis (Wales, 1937).
[3] La Rue, C. D., *Mich. Acad. Sci., Arts and Letters*, **13**, 131 (1931).

Structure of Permian Homoptera and Psocoptera

THE recent note in NATURE[1] on the ancestors of some groups of existing insects prompts me to mention certain facts apparently overlooked by Prof. G. Zalessky, and to direct attention to others bearing on the subject. Zalessky announces his discovery that the Permian Psocoptera had a "proboscis-shaped" head, provided with a sucking apparatus similar to that of the Homoptera. In 1933[2] I gave a detailed account, which is not mentioned by Zalessky, of the body structure of the Kansan Permian Psocoptera, and demonstrated then (Fig. 13, and plate 1, Fig. 4) that the head possessed a prominent rostrum. The significant feature of the rostrum of these Psocoptera is the presence of large and generalized maxillary and labial palpi, which are scarcely suggestive of the structure of the piercing beak of the Homoptera. Zalessky also states that he doubts the correctness of Dr. R. J. Tillyard's description of the chewing mouth-parts in *Psocidium*. This description I corrected in 1932[3] and at the same time showed *Psocidium* Till. to be a synonym of *Dichentomum* Till., as it was later regarded by Dr. Tillyard[4].

Zalessky also notes his discovery that the members of the order Hemipsocoptera, which was established by him in 1936[5], similarly possessed a "proboscis-shaped" head and mouth-parts like those of the Homoptera. The species for which he erected this new order, *Mauria sylvensis* Zal., was based upon a single and poorly preserved specimen, showing the more general features of both fore and hind wings. At that time (1936) the nature of the hind wings of the Permian Homoptera was not known, and Zalessky, noting that the hind pair of *Mauria* suggested the wings of the Permian Psocoptera, and the fore pair those of the Permian Homoptera (Archescytinidæ), made the new order Hemipsocoptera for the genus. In 1935 I collected in the Permian strata of Kansas a number of Homoptera belonging to several genera of the family Archescytinidæ, descriptions of which are now in press. The hind wings have a venation like that of *Maurii* and the fossils show beyond doubt that the latter is nothing more than a typical member of the Homopterous family Archescytinidæ. It is not surprising, therefore, that the members of the "order" Hemipsocoptera possessed sucking mouth-parts like those of the Homoptera, for as I have already shown (1931)[6], the Archescytinidæ had a perfectly developed haustellate beak, with a swollen clypeal region, and piercing stylets.

The close relationship between the Psocoptera and the Homoptera has been recognized for many years by students of insect phylogeny and morphology, and the similarity between the Permian representatives of these two groups is, of course, very striking. It is unfortunate that Zalessky did not wait for more satisfactorily preserved specimens of *Mauria* before he established a new order.

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[1] NATURE, **140**, 847 (Nov. 13, 1937).
[2] *Proc. Amer. Acad. Arts Sci.*, **68**, 446 (1933).
[3] *Amer. J. Sci.*, (5) **24**, 4 (1932).
[4] *Proc. Linn. Soc. N.S.W.*, **60**, 267 (1935).
[5] *Ann. Soc. Geol. Nord*, **60**, 51 (1936).
[6] *Amer. J. Sci.*, (5) **22**, 116 (1931).

Points from Foregoing Letters

A NEW type of monochromator, built up of a number of 'Polaroid' films with intermediate quartz plates, is described by Prof. Yngve Öhman, who calculates the intensity of distribution in a spectrum transmitted by such a filter. Single bands of about 50 A. can be separated. Photographs are submitted comparing results obtained with a grating spectrograph and with the new instrument, which appears to be especially useful in observing solar prominences, since the field of view is not limited by a slit as in the ordinary spectrograph.

From X-ray photographs of crystals of ammonia-nickel-nitrate, $Ni(NO_3)_2 . 6NH_3$, S. H. Yü concludes that the behaviour of the NO_3 group in those crystals must be abnormal, and submits diagrams of possible structure which allows for an abnormally large oscillation of the nitrate group. This may be correlated with the large amount of heat motion of the atoms, indicated by the rapid decrease of intensities of the X-ray reflections with increase of glancing angle. Cooling the crystals to the temperature of liquid air produces contraction (at $-100°$ C.) followed by expansion, while the colour changes from blue-violet to dark purple and then to brilliant pink.

Dr. D. F. Martyn and G. H. Munro have identified a second ordinary echo from the *F* region of the ionosphere at frequencies below the Larmor gyro-frequency $f_1 = He/m$. The retardation of this echo increases, and it eventually disappears just below the frequency $f_1 \cos\theta$, where θ is the complement of the inclination of the earth's magnetic field. The discovery of this echo shows that the Lorentz polarization term is not to be applied in the treatment of dispersion in the ionosphere, and provides a means of measuring the earth's magnetic field in the ionosphere with greater accuracy than was hitherto possible.

Diagrams of transverse sections of the mantle edge of the spat of the oyster before and after attachment are submitted by H. A. Cole. They show in the later stage the existence of a pair of organs not found in the free-swimming larvæ and possibly serving to receive, and react to, vibrations caused by disturbances in the surrounding medium. The newly described sense-organs appear as thin-walled spherical pigmented sacs forming part of the surface layer of cells, projecting from the inside mantle surface and containing, in the cavity, a comparatively large concretion which stains vividly with eosin.

Prof. N. A. Iljin gives an account of experiments in which the shedding of certain types of wool fibres in sheep while other types of wool fibres remain unchanged, is produced by means of treatment with thallium acetate. This phenomenon, termed 'selective or differential experimental moult', is considered as a peculiar morphogenetic reaction; it is evidence of the possibility of a physiological distinction between morphologically different structures proper to the race with a certain genetical constitution.

Prof. H. Munro Fox shows that certain sabellid worms removed from their tubes live indefinitely in aerated water, but they die in water deficient in oxygen, whereas intact worms live in the latter water. In their tubes, these sabellids execute rhythmic respiratory movements, the absence of which in tubeless worms may account for their lower viability. The absence of rhythmic movements in tubeless worms is reflected in their lowered metabolism.

The death of two swans from lesions of the intestine is tentatively ascribed by E. Gray to the presence of diatoms entangled in weeds ingested in early spring, combined with a high percentage of silica in the water.

Prof. D. Thoday directs attention to Dr. Razvi's observation that the opening of the stomata in the leaves of certain succulent plants depends not on the water-content of the leaf as a whole but on the water-content of the surface layer of cells. This, Prof. Thoday suggests, may explain why in the leaves of the coffee plant the stomata begin to close within three minutes of exposure to the sun, though the water supply may be abundant.

Research Items

Identification of Vitamin C

PROF. G. J. COX, in a letter to *Science* (Dec. 10, 1937; p. 540) points out that the award of the Nobel prize for medicine to Prof. A. v. Szent-Györgyi (see NATURE, **140**, 798; 1937) may tend to obscure the part played by C. G. King and W. A. Waugh, of the University of Pittsburgh, in establishing the identity of vitamin C with a pure crystalline substance. The two groups of investigators, in fact, reached their goal by converging paths, at almost the same time. King and Waugh isolated active crystals from lemon juice and considered the substance to be apparently identical with Szent-Györgyi's "hexuronic acid", and published a note of their results early in 1932 (*Science*, **75**, 357; 1932). Svirbely and Szent-Györgyi announced, about a fortnight later, that they had protected guinea pigs from scurvy, in an experiment lasting two months, by giving them daily doses of "hexuronic acid" (NATURE, **129**, 576; 1932). It must be remembered that the question of the potency of the "hexuronic acid" was not easy to settle, since until it was certain that it had been obtained in the perfectly pure state there was always the possibility to be considered that it was contaminated by another much more highly active substance.

Osmotic Pressure

PROBABLY no conception in physical chemistry is used so often by biologists, with such lack of understanding of its precise nature, as that of osmotic pressure. The so-called pressure is clearly quite fictitious, and corresponds only in very special circumstances to any real pressure. In many quarters, the necessity for a new term to describe the effect is already being felt, and a recent addition to the series "Actualités scientifiques et industrielles" (Duclaux, J., "Pression Osmotique". Traité de Chimie physique appliqué à la Biologie, Tome 2, chap. iv. Paris: Hermann et Cie.) serves to emphasize this view. Although the treatment there is chiefly mathematical, the book is well worth the attention of biologists for its conclusions alone. The original comparison by Van't Hoff with gas pressure, interpreted in terms of the kinetic theory by Nernst, Meyer, Boltzmann, Rayleigh, Kelvin, Gibbs and others, is inadequate in many respects; for attention is concentrated on the solute rather than the solvent, and no account is taken of the two characteristics of osmosis—that the pressure is 'fictitious' and that the volume to be used in the van der Waals equation $PV = RT$ is not the whole volume of the solution. Considerations of the thermodynamical principles involved, made by Van't Hoff, Rayleigh, Gibbs, Planck and others, are equally inadequate, and the various theories they involve would seem to be incompatible. The only satisfactory theoretical expositions of the subject would seem to be those involving the Gouy-Chaperon effect, according to which, in a solution under the influence of gravity, the concentration varies with the height. The chief feature of importance to biologists is the clear recognition that in practice few membranes approach sufficiently closely to the theoretical 'normal' membranes to allow any rigid application of theoretical considerations—in other words, 'abnormal' osmosis in Nature is the rule rather than the exception. One may quote, for example, the fact that the blood of a fish has a concentration lower than that of sea-water, and that urine is more concentrated than blood. In all such cases the equilibrium must be far removed from that of Van't Hoff.

Choice of Background in Fishes

THE colour-change in fishes which takes place when they move from one background to another of different colour has been investigated on several occasions, but not much is known about the possibility of fishes selecting backgrounds to correspond with their skin colour. Observations have been interpreted as yielding positive and negative evidence of choice. Frank A. Brown and David H. Thompson record the results of several thousand choices of individual background-adapted fishes, belonging to eight fresh-water species (*Copeia*, 172; 1937). They reach the definite conclusion that fishes are influenced in their choice by the background to which their skin is adapted. Fishes adapted to black backgrounds choose black more frequently than do fishes adapted to white backgrounds. But in all the eight species tested black-adapted individuals chose black more often than white-adapted chose white. The fishes which showed the greatest modification of background choice as a result of residence upon a black or a white background (silver-mouthed minnow, steel-coloured minnow, straw-coloured minnow, and black-fin) were fishes which frequent shallow and relatively clear water in their natural habitat. The less sensitive were species (orange-spotted sunfish and horned dace) which characteristically hide during a large part of the time.

Larval Characters of the Brachyura

DR. HIROAKI AIKAWA has already advanced considerably our knowledge of the brachyuran larvæ (1933, 1935, 1936) and has devised schemes whereby they may be recognized and classified. In his latest paper "Further Notes on Brachyuran Larvæ" (Records of Oceanographic Works in Japan compiled by the Committee on Pacific Oceanography of the National Research Council of Japan. Tokyo, 1937) he extends these schemes in the light of a large number of new larvæ (30 species) obtained by himself by rearing them from the berried crabs. Taking certain larval characters, especially the second antenna and telson, presence or absence of spines on the carapace, and, in some cases, in addition, the hair formula of the endopodites of the two maxillæ and second maxillipede and the primary chromatophores, he attempts to define the larval characters of the important families including the zoeas of Japanese crabs as well as those of other countries. So great has been the advance in our knowledge of crab zoeas during the last few years that we now know, to a certain extent, the larvæ of 150 species and about 70 genera. Dr. Aikawa has classified all these and

gives a key to the families based on larval characters. Applying this also to undetermined zoeas described by various authors, he suggests their probable position. It is interesting that in several cases two megalopæ are found in the life-cycle, whereas certainly in all the British species in which the life-cycle is known there is only one. In *Plagusia dentipes* it is stated that megalopa I stage forms swarms in the open seas from late winter until spring, whilst those of II stage live in great abundance on floating weeds and timbers from spring until early summer.

A Parasite of the Hessian Fly

IN the *Journal of Agricultural Research* (**55**, 199–213; 1937), Messrs. C. C. Hill and W. T. Emery give an account of the biology of the parasitic hymenopteron, *Platygaster herricki*, the host of which is the Hessian fly. In certain parts of the United States, this parasite destroys an appreciable percentage of the fly. Its egg is laid in that of the host, wherein it develops simultaneously with the latter. Development is monoembryonic and not polyembryonic, as in related species of *Platygaster*, and, at the time of hatching, numerous pseudogerms, or groups of trophamnion cells, are liberated into the body cavity of the host. The primary larva at this stage is about 0·29 mm. long: it becomes nearly spherical during growth and gradually consumes the inner contents of the host, but not before the puparium has been formed. When fully fed, the parasite forms a cocoon within the host's puparium. The adult hibernates within the cocoon and emerges in the spring at the time when the Hessian flies are ovipositing. There is only a single generation in the year.

Heart-Rot of Sugar Beet

SUGAR BEET is subject to a severe disease the symptoms of which are a rotting of portions of the root, and frequently the death of the terminal bud. It is now recognized that this malady is occasioned by a deficiency of boron in the soil. Drs. Winifred E. Brenchley and D. J. Watson have made a study of the effect of this element upon the second year's growth of infected sugar beet (*Ann. App. Biol.*, **24**, 3, 494–503, Aug. 1937). Diseased plants from the field were transferred to sand cultures, some of which contained the deficient element in the form of boric acid. Growth made in the absence of boric acid was uniformly diseased, but the addition of this substance in moderate amount (0·25 gm. per 25 lb. of sand) invariably corrected the trouble. Application of a double amount of boric acid, however, had a somewhat toxic effect.

Root Nodules of the Soy Bean

A SHORT account, by Chan Hsien Wu, of the strains of *Bacillus radicicola* from root nodules of the soy bean, is published in the report of the Institute of Scientific Research, Manchoukuo (**1**, No. 5, 139–162, April 1937). Morphological and cultural characters are described, and the effect of the reaction of the medium upon growth has been investigated. The optimum reaction is about *p*H 6·5, though the organism will grow between the limits *p*H 3·7 and 7·8. Fermentation tests with various polyhydric alcohols, sugars and organic acid salts have been made; mannitol supported the best growth.

Entomogenous Fungi

MR. T. PETCH has continued his "Notes on Entomogenous Fungi" (*Trans. Brit. Mycol. Soc.*, **21**, Pts. 1 and 2, 34, Oct. 1937), and provides critical dissertations upon thirty-four species. No fewer than fifteen of these are described for the first time, and thereby attain the dignity of Latin diagnoses. The species belong to a wide variety of genera—*Entomophthora*, *Hypocrella*, *Cordyceps*, *Hirsutella*, *Calonectria*, *Torrubiella*, *Stilbella*, *Isaria*, *Hymenostilbe* and others. The study includes specimens from North America, Ceylon, China, Silesia, Trinidad, Great Britain and many other places the full recital of which would be eloquent of the international scale of Mr. Petch's work.

Fault Lines off Spitsbergen

THE recent Norwegian chart of the west coast of Spitsbergen based on extensive echo soundings reveals some submarine features of interest. These are discussed by Dr. O. Holtedahl in *Norsk Geografisk Tidsskrift*, Band 6, Hefte 4, 1936 (republished as *Norges Svalbard og Ishavs-undersökelser Meddelelse* No. 35). He finds a number of features which resemble closely others found off the coast of northern Norway, especially a longitudinal depression off the coast of Prince Charles Foreland and, more to the east, off the land to north and south. This feature is attributed to longitudinal faults, and these have also been traced in the shelf areas off the coast of Western Greenland. Dr. Holtedahl points to the probability of similar fault lines off Labrador just east of Hamilton Inlet and off Nova Scotia along the inner slope of George's Bank. Similar features may be expected to occur off the west coast of Scotland, although Cainozoic volcanic activity may there have disguised them. Dr. Holtedahl illustrates his paper with a chart of the probable fault line off the west coast of Spitsbergen.

Earthquakes and Atmospheric Pressure

THE effects of changes of atmospheric pressure on the occurrence of about two hundred New Zealand earthquakes from 1931 until 1936 are examined by Mr. R. C. Hayes in a brief but interesting paper (*Wellington Dom. Obs. Bull.*, No. 124; 1937). When the pressure rose or fell by one tenth of an inch or more within one or two days before an earthquake, a positive or negative sign was entered at the position of the epicentre. In general, it was found that earthquakes with centres on land were associated with a rise of pressure, and those with centres at sea with a fall, the different signs predominating in series of zones running north-east and south-west, parallel to the main folds and fault-systems of the islands. The most extensive zone is one marked by negative signs lying off the east coast of the North Island, and this is bounded to the north-west by an almost equally well-defined zone on land with positive signs.

Ice Accretion on Aircraft

IN Prof. Note No. 82 of the Meteorological Office under the title "Ice Accretion on Aircraft" (London: H.M.S.O.), Sir G. C. Simpson discusses in turn the physics, the meteorology and the practical side of this subject. The physics is a simple matter. We have first the common phenomenon of clouds made up of water

drops below the normal freezing point of water and the fact that the latent heat released when such a 'supercooled' drop begins to freeze prevents freezing from being at once completed unless the drop is at least 144° F. below 32° F. The manner of accretion of ice on aircraft is a matter of the size of the drops and of temperature; there are four main types of accretion corresponding with hoar frost, rime, something between rime and glazed frost, and glazed frost. The first may form in clear air when an aeroplane passes from regions of very low temperature into warmer and damper regions and is not thick enough to be very dangerous. The second—rime—comes when the machine flies in clouds made up of very small drops, generally at temperatures many degrees below 32° F. It is a light white deposit on the leading edges of wings, struts, etc., and is dangerous through its alteration of the aerodynamical characteristics of such parts and choking of instruments and carburettor. The third comes in dense clouds made up of large drops more nearly at 32° F. Freezing is very incomplete at impact, and the drops flow for some distance, gradually covering the machine with a dangerously heavy covering of clear ice. Lastly we have glazed frost, which is a similar covering of clear ice, the result of rain from a warmer layer above falling on a machine in a layer with temperature below 32° F. The meteorology of the subject is concerned with the development of rain clouds at suitable temperatures, and is not dealt with in great detail; the practical side is largely concerned with the problem of escaping the dangers of ice accretion either by ascending or descending out of the dangerous layer according to the meteorological circumstances and aided by the wireless warnings issued by the Meteorological Office.

Uranium, Thorium and Lead in Thucholite

THE radioactive carbon mineral thucholite, found in the Parry Sound district, Ontario, has been analysed by O. B. Muench (*J. Amer. Chem. Soc.*, **59**, 2269; 1937). Well-defined crystals, regarded as pseudomorphs after uraninite, were available. The ratio Pb/U was 0·038, whilst that in cyrtolite from the same mine was 0·019. The percentage of uranium in nodular thucholite was almost four times that in the crystalline material, whilst the percentage of thorium was four to five times as great in the crystals as in the nodular mineral. These results indicate a possibility of a concentration of thorium in the crystals and either a leaching of the uranium or else a replacement of the uranium by the carbon mineral. They indicate that Pb/U ratios for this mineral are of little value for an age-determination by this method.

Effect of Temperature on Permanent Magnets

IT has been known for many years that the strength of a permanent magnet changes with alteration of its temperature. In general, the strength diminishes when the temperature is raised and increases when it is lowered. In the case of highly accurate instruments such as electricity meters, the constancy of the strength of the magnets used is of very great importance. It is especially important in the case of the electrical instruments which use permanent magnets employed on aircraft. In view of the recent developments that have been made in the electromagnetic instruments used in high altitude flying where very low temperatures are encountered, it is necessary to know the behaviour of magnets at these temperatures. In a paper by Albert C. Whiffen, published in the December issue of the *Journal of the Institution of Electrical Engineers*, a survey is given of recent researches on this subject. It has been proved that a magnet can be put into the steady condition, as regards magnetic strength, either by mechanical shocks or by cyclic heating. It then has a definite strength at each temperature. A survey of previous experiments shows that the change with temperature depends on the linear dimensions of the magnet. Tests were made of cobalt steel, aluminium-nickel and aluminium-nickel-cobalt alloy magnets over the temperature range from −60° C. to 100° C. An electrically heated oil bath was used for the range 20° C. to 100° C., whilst solid carbon dioxide dissolved in acetone was employed for the range 20° C. to − 60° C. It was found that the magnetic strength at any temperature between these limits could be connected with the standard temperature by a quadratic coefficient, both coefficients being negative. It is stated that a magnet which has attained the reversible condition by a series of heating cycles between two limits of temperature is only in the reversible state for these limits of temperature.

Green Flash from Venus

THREE observations of the 'green flash' phenomenon from the planet Venus as it was setting behind a sea horizon are recorded in the meteorological record of S.S. *Tairoa* by Captain W. G. West and W. G. Burt (*Marine Observer*, **15**, 8; 1938). On January 4, 1937, in lat. 1° 00′ S., long. 70° 04′ E., the setting planet, watched through binoculars, turned to a deep green for about half a second before disappearing. On January 5, when the planet was watched through a telescope for five minutes before setting, there were periods of 1–3 or 4 seconds during which the body would appear elongated vertically, with red at the lower limb and green at the upper; the final colour was a dull green. On January 19, when the planet, again watched through a telescope, was only a few minutes of arc above the horizon, a reflection on to the horizon was observed, bright and yellowish in colour. Then "it turned bright red, and as a pillar of red spreading down from the planet to the horizon. After turning back to yellowish-white, it turned green, and then seemed to sink out of sight rather quickly. The whole of this latter phenomenon lasted for not more than 4 seconds."

Most Accurate Method for Determining Meteor Radiants

IN "Extrait, Congrès International des Mathematiciens, Oslo, 1936", Jindrich Svoboda has a paper with the title, "Les Essais expérimentaux du calcul d'un radiant du courant météorique des trajets observés", in which he describes his experiments with a group of artificial meteors. Knowing the true radiant, he used different methods for finding the nearest approach to this, and though the results did not differ very much, one was undoubtedly superior to the others. It was found that when the sum of the squares of the angles by which the lines should be turned around the centre of each trajectory, in order that these lines should pass through the computed radiant, was a minimum, the best results were obtained. Meteor workers may find this conclusion of considerable value.

The Advancement of Science and Society

PROPOSED WORLD ASSOCIATION

AT the recent Indianapolis meeting of the American Association for the Advancement of Science, two important resolutions were adopted unanimously by the Council and may have profound effects, not only upon the future of science, but also upon social history. The resolutions propose, in effect, the setting up of a scientific 'brains trust' for the world, and proclaim the democratic principles of science, and the intellectual freedom of scientific workers; and they denounce totalitarian suppression as a major crime against civilization.

This action may be said to have had its origin in a movement, started several years ago, and strongly supported by NATURE, to make the British Association the platform for the discussion of social problems which science had helped to create and might help to solve. By the time of the Blackpool meeting in 1936, the success of the British Association in this field was manifest. The American delegates, led by Prof. E. G. Conklin, were greatly impressed by the spirit of the meeting. They wanted to hear the men of science of the United States speak as freely, and constructively, on social issues.

Among the American visitors was Mr. Waldemar Kaempffert. Mr. Ritchie Calder, who had already discussed the ideas with leading British men of science, proposed with Mr. Kaempffert 'A Magna Charta of Science'—a declaration of independence, declaring the free, democratic, altruistic principles of science, and also the formation of an Anglo-American concord, as the nucleus of a world organization for all who would subscribe to, and advance, these principles. Together, they saw Prof. Conklin, who wholeheartedly approved, and Sir Josiah Stamp. Coincidentally, Prof. Étienne Gilson, professor of the history of philosophy in the Middle Ages in the Collège de France, was proposing, at the Harvard tercentenary, the setting up of a 'Supreme Court of Science' for the world.

The British Association, during 1937, entered into negotiation with the American Association for collateral membership and exchange of publications, but the major proposals were deferred. In October 1937, however, the *New York Times* published a leading article on an open letter which Mr. Ritchie Calder had addressed, in the *Daily Herald*, to Lord Rayleigh, reviving the proposals. The response in the United States was immediate. Dr. F. R. Moulton, executive secretary of the American Association, made the proposals the basis of his address last December to the Council, in which he also proposed that the American Association should invite lay members, mostly from the universities, to the number of one hundred thousand. The symposium on science and society, Prof. Conklin's inspiring address on science and ethics (see NATURE, Jan. 15), and Dr. Moulton's appeal assured the enthusiastic reception of the proposals. On December 30, the Council of the Association responded by unanimously endorsing the following resolutions:

"Whereas, science and its applications are not only transforming the physical and mental environment of men, but are adding greatly to the complexities of the social, economic and political relations among them; and

"Whereas, science is wholly independent of national boundaries and races and creeds and can flourish permanently only where there is peace and intellectual freedom: now

"Therefore, Be it resolved by the council on this thirtieth day of December 1937, that the American Association for the Advancement of Science makes as one of its objectives an examination of the profound effects of science upon society; and that the Association extends to its prototype, the British Association for the Advancement of Science, and to all other scientific organizations with similar aims throughout the world, an invitation to co-operate, not only in advancing the interests of science, but also in promoting peace among nations and intellectual freedom in order that science may continue to advance and spread more abundantly its benefits to all mankind."

The Association at the same time reaffirmed a resolution on intellectual freedom, originally presented by Dr. Robert A. Millikan and Prof. Henry Norris Russell. The Millikan-Russell resolution, incorporated in the new declaration, reads:

"The American Association for the Advancement of Science feels grave concern over persistent and threatening inroads upon intellectual freedom which have been made in recent times in many parts of the world.

"Our existing liberties have been won through ages of struggle and at enormous cost. If these are lost or seriously impaired there can be no hope of continued progress in science, or justice in Government, of international or domestic peace, or even of lasting material well-being.

"We regard the suppression of independent thought and of its free expression as a major crime against civilization itself. Yet oppression of this sort has been inflicted upon investigators, scholars, teachers and professional men in many ways, whether by government action, administrative coercion or extra-legal violence.

"We feel it our duty to denounce all such actions as intolerable forms of tyranny.

"There can be no compromise on this issue, for even the commonwealth of learning cannot endure 'half slave and half free'. By our life and training as scientists and by our heritage as Americans we must stand for freedom."

As one of the first steps to create the machinery, Dr. Moulton was requested by the council "to take up with the British Association the question of the desirability of inviting its members to join the American Association", so that the combined scientific forces of America and Great Britain should act as a "united world intellect".

Another gesture, which was warmly received by the American men of science, was the announcement made by Sir William Bragg in his presidential address to the Royal Society on November 30 last that the National Academy of Sciences of the United States of America and the Royal Society of London had arranged for the exchange of lectureships between the two democracies in alternate years. An account of this endowment by the Pilgrim Trust was given in NATURE of December 4, 1937 (140, 961).

Geography and Planning

THE Geographical Association's annual conference usually has a theme corresponding to the interests of its president for the time being, and since in its choice of presidents the Association does not confine itself to academic geographers, considerable service to the subject is often done by this importation of a new viewpoint. This year the keynote of the Conference held at the London School of Economics on January 4–6 was the part that geography can play in planning. The presidential address, delivered by Prof. Patrick Abercrombie, professor of town planning at University College, London, was entitled "Geography, the Basis of Planning"; and a symposium on town and rural planning was the principal individual item in the programme. To a certain extent these items in the Conference may be considered as corollary to the important discussion on "Planning the Land of Britain", which was held at the Nottingham meeting of the British Association, as reported in NATURE of November 6, 1937, p. 791.

Prof. Abercrombie took as his starting point the famous Geddes triad "place, work, folk"; geography (place) represents the basis of planning, business (or work) the kernel of planning, and men and women (or folk) the purpose of planning. Planning may be defined as "any conscious effort to mould our environment for our own purposes". The geographer's aid to planning can be given by three types of study: the recording of natural conditions (geology, soil, vegetation, etc.), the tracing of the historic growth of adaptation to environment in the region, and, by combining these two, the presentation of a survey of existing conditions. A plea was put forward for the popularization of geology; the Geological Survey provides ample material in the shape of maps and memoirs, but few people can interpret them without the aid of the professional geologist, and numerous fundamental errors have been made in planning which might have been prevented by a little elementary geological knowledge.

Dr. S. W. Wooldridge, however, in the symposium, contended that the matter is one for geographers; the geologist studies rocks mainly as a record of the earth's history, and is not primarily concerned with the form of the land, and its surface constitution. Both Prof. Abercrombie and Dr. Wooldridge pleaded for soil maps, but had little hope of their appearance for many years. But a more serious handicap is the absence of a complete drift map covering the whole country; the past and present geography of the drift-covered areas cannot be fully appreciated without a map showing the character of the surface deposits.

Dr. Wooldridge said, in addition, that for studying the form of the land something more than contour maps is necessary, and he deplored the abandonment of the fifth (Relief) edition of the Ordnance Survey One-Inch Map—a sentiment which was obviously shared by an audience consisting very largely of school-teachers. Another matter in which the planner must be interested is structure, especially in its effect on water supply. Dr. Wooldridge showed how sub-surface contour maps of water-bearing formations may be far more useful than simple cross-sections; for example, it may be demonstrated that the chalk is much nearer the surface underneath the central part of London than in the regions to the west and east, a fact which has an obvious bearing on the relative difficulty of securing water by boring. He cited cases, too, of buildings which had subsided through being built on a shallow clay formation overlying running sands, and mentioned that central London, built on Thames terrace gravels, is the only part that has subsided appreciably, the parts built on London Clay showing no movement. He added a warning that the expansion of 'bungaloid growths' on the top of the chalk dip-slope around London may have disastrous effects on the pollution of the water, which runs down the dip to the areas from which well-water is obtained.

Both Prof. Abercrombie and Dr. Willatts were concerned with agriculture, which the former called the "Cinderella of planning". There is a well-known phrase "an army moves on its stomach"; it is equally true that the non-combatants must be fed in time of war, and in an island country such as Great Britain, it seems curious that so much attention should be given to the production of weapons of defence and aggression, and so little to the possibility of making the nation more self-supporting in essential foodstuffs. Agriculture, in the law, is not regarded as a development at all; 'development' consists of the utilization of the land for building purposes, and planning schemes plan the extension of urban areas, not the extension, nor even the retention, of agricultural land-use. The land, as Dr. Stamp said at Nottingham, is our one ultimate asset; the soil is a form of capital; yet not only have three-quarters of a million acres of farm-land been lost to the nation since 1900, but also, by a curious misfortune, it is usually the best agricultural land which is taken for building.

Dr. Willatts, who is organizing secretary of the Land Utilization Survey, stressed the need for a historical study of land utilization. The present use represents the result of centuries of adaptation; modern planning visualizes a sudden change. Only by studying the past land uses can apprisal be made of the optimum use of any given area. Thus near London there are three large areas of rich market-garden land—actually amongst the finest soils in the country, in western Middlesex, south-west Essex and north-west Kent—all of which are being rapidly eaten into by the builder. No account whatever seems to have been taken of the agricultural value of this land, either in planned or haphazard development. It is noteworthy that London's open heaths (for example, Hampstead, Wimbledon) have remained as such for centuries because of poverty of soil; they would make admirable residential areas, yet what an outcry there would be if they were to be built on! But thousands of acres of rich arable land, which for centuries has yielded abundant harvests to the farmer or small-holder, are now being destroyed by houses and factories without a protest being raised. The 'gravel subsoil' of the Thames terraces is far more valuable to the builder as an inducement to the prospective purchaser than the poorer clay land, and could far better be spared from

the rapidly decreasing area of farm land. The question which the geographer, and the planner, may ask is, "Which is the best and most economic use of this land, considered from the national point of view—for houses or crops?"

Lastly, Dr. R. A. Pelham urged a better appreciation of traditional building styles and materials in the development particularly of rural areas, in order that such "incongruous atrocities" as rows of red brick houses on the edge of Cotswold towns and villages might be avoided. It is feared, however, that this is an age in which utility and cheapness are more often considered than the æsthetic, and it is after all much cheaper and easier to build with mass-produced bricks than with elaborately prepared stone.

Apart from a highly entertaining and unbiased lantern lecture on South Russia and the Caucasus by Sir John Russell, and a fascinating biological introduction to the study of landscape from Prof. H. H. Swinnerton, the remaining items in the Conference dealt mainly with educational subjects, ranging from the conception of geographical ideas by school-children to the conception of examination questions by examiners, and from the study of local geography by observation to the study of far-off lands by corresponding with the officers of 'tramp' ships. A lengthy report of a committee of the Association which has been studying world natural regions was also submitted and discussed; the report has been published in full in the December 1937 issue of *Geography*.

S. H. BEAVER.

Prize Awards for 1937 of the Paris Academy of Sciences

AT the annual public meeting held on December 20 last the president announced the prizes and grants awarded in 1937 as follows:

Mathematics. The Francœur Prize to Jean Leray, for his work on mathematical analysis.

Mechanics. The Montyon Prize to Lucien Malavard, for his electrical apparatus for the rapid calculation of the distribution of hydrodynamic circulations. The Poncelet Prize to Joseph Bethenod, for his work on mechanics and electricity. The Pierson-Perrin Prize to Léon Brillouin, for the whole of his work, especially for his contributions to the development of quantum mechanics.

Astronomy. The Lalande Prize to Michel Giacobini, for his work on stellar astronomy and comets. The Benjamin Valz Prize to Maurice Burgaud, for his work on terrestrial magnetism in China. The G. de Pontecoulant Prize to Henri Roure, for his work on planetary perturbations.

Geography. The Gay Prize to Jean Vignal, for his work on the accuracy of a method of levelling. The Tchihatchef Prize to Etienne Bruzon, for his travels, work and publications relating to the climate of Indo-China. The Binoux Prize to Raoul Goudey and Jean Lagrula, for their gravimetric observations made in France and Northern Africa. The Alexandre Givry Prize to Henri Legrand, for the whole of his hydrographical work in France and its colonies.

Navigation. The Plumey Prize to Roger Brard, for his studies on screw propellers.

Physics. The Kastner-Boursault Prize to Bernard Decaux, for his work on the applications of piezo-electric quartz to chronometry. The Gaston Planté Prize to Jean Bernamont, for his studies on the fluctuations of electrical resistances. The François Hébert Prize to Paul Couderc, for his work on astronomy. The Henri de Parville Prize to Paul Lainé, for his researches on the magnetic and magneto-optic properties of liquefied gases. The Hughes Prize to Paul Soleillet, for his work on the structure of light. The Clément-Félix Foundation to Etienne Vassy, for his work on atmospheric ozone.

Chemistry. The Montyon Prize (Unhealthy Trades) to Roger Renaud, for his work on gas masks. The Jecker Prize to Gustave Vavon, for his work on catalytic hydrogenation and the stereochemistry of the cyclic compounds. The Cahours Foundation to Georges Laude, for his work on the synthesis of cyanic acid. The Paul Marguerite de la Charlonie Prize to Georges Darzens, for his work in organic chemistry. The Berthelot Prize to Jacques Parrod, for his researches on the synthesis of hydrocyanic acid. The Houzeau Prize to Marius Picon, for his work on sulphides and camphocarbonates. The Charles Adam Girard Foundation to Georges Brooks, for his researches in biological chemistry.

Mineralogy and Geology. The Delesse Prize to Mlle. Simonne Caillère, for her work on the minerals of the serpentine group. The Victor Raulin Prize to Mlle. Henriette Alimen, for her studies on the Stampian of the Paris basin.

Botany. The Desmazières Prize to Robert Potier de La Varde, for his work entitled "Mousses du Gabon". The Montagne Prize to Marius Chadefaud, for his work on Algæ. The Jean Thore Prize to Emile Chemin, for his biological researches on certain Algæ. The de la Fons Mélicocq Prize to Maurice Bouly de Lesdain, for his work entitled "Graminées indigènes et adventices des environs de Dunkerque". The de Coincy Prize to Raymond Benoist, for work in systematic botany in tropical regions.

Anatomy and Zoology. The Cuvier Prize to Paul Chabanaud, for the whole of his work. The Savigny Foundation to Henri Heim de Balsac, for his book on the mammals and birds of northern Africa.

Medicine and Surgery. Montyon Prizes to Emile Césari and Paul Boquet (2,500 francs), for their researches on the antigens of snake poisons and the antibodies of the sera; Michel Salmon (2,500 francs), for his book on the arteries of the skin; Jean Vague (2,500 francs), for his book "Les Hépatonephrites aiguës". Honorable Mentions (1,500 francs) to Ram Kumar Goyal, for his contribution to the study of the Streptothricæ; to Eugène Saint-Jacques, for his work on injections of animal charcoal in various diseases; and to Jean Terracol, for his book on the diseases of the nasal fossa. The Barbier Prize to P. Emile Weil, Paul Isch Wall and Mme. Suzanne Perlès, for their book on the puncture of the spleen. The Bréant Prize to Georges Girard and Jean Robic, for their work on the application to man of a new vaccine against plague. The Godard Prize to Gaston Gros, for his memoir on sexual endocrinology. The Mège Prize to Georges Curasson, for his treatise on

veterinary pathology. The Bellion Prize to Jacques Vialle, Chevalier Jackson and Chevalier L. Jackson, for their memoir on bronchoscopy in broncho-pulmonary affections. The Argut Prize to Jean Braine and Raymond Rivoire, for their book on the surgery of the parathyroid glands. The Charles Bouchard Foundation to Maurice Doladilhe, for his studies on the properties of the blood serum. The Jean Dagnan-Bouveret Prize to Michel Weinberg, for his memoir on the anærobic micro-organisms.

Cancer and Tuberculosis. The Roy-Vaucouloux Foundation to Eugene Wollman, for his work on the nature of malignant tumours. The Louise Darracq Prize to Mme. Nadine Dobrovolskaia-Zavadskaia, for work on cancer. The Henriette Régnier Foundation to Robert Broca, for work on tuberculosis.

Physiology. The Montyon Prize to Mlle. Eliane Le Breton, for her memoir on the physiological signification of the oxidation of ethyl alcohol in the organism. The Pourat Prize to Georges Morin, for his work on the intestinal automatism of the vertebrates and its regulation. The Philipeaux Prize to Jean Roche, for his physiological and biological researches on the respiratory pigments. The Fanny Emden Prize between André Tournade (2,000 francs), for researches in experimental physiology, and Raoul Lecoq (1,000 francs), for researches on the B vitamins.

Statistics. Montyon Prizes to Mlle. Dagmare Weinberg (1,000 francs), for her work on the correction of examination papers; Adolphe Lesage and Marcel Moine (1,000 francs), for their study on infant mortality during the first year. A Mention (500 francs) to Marcel Luc-Vernon, for his studies on the science of values applied to bookkeeping and the statistics of undertakings.

History and Philosophy of Science. The Binoux Prize to Cornelis de Waard, for his contribution to the edition of the correspondence of Père Marin Mersenne.

Works of Science. The Henri de Parville Prize to the Association de la Presse de l'Institut et des Sociétés Savantes.

Medals. The Berthelot Medal to Roger Renaud and to Jacques Parrod.

General Prizes. The Prize founded by the State to Gaston Delépine, for the whole of his palæontological and geological work. The Alhumbert Prize to (the late) Fernand Jacquet, for his researches on the stratigraphy of Senegal and Mauritania. The Bordin Prize to Georges Darmois, for his work on the calculus of probabilities. The Lallemand Prize to Jean Delay, for his work entitled "Les Astéréognosies. Pathologie du toucher". The Petit d'Ormoy Prize (Mathematical Sciences) to Paul Lévy, for the whole of his mathematical work, (Natural Sciences) to Emile Roubaud, for the whole of his entomological and biological work. The Saintour Prize to André Marchaud, for his work on geometry. The Lonchampt Prize to Lazare Silberstein, for the whole of his work on the importance of sulphur in plants and animals. The Wilde Prize to René Lucas, for his work on transversal waves in liquids. The Gustave Roux Prize to Stanislas Goldsztaub, for his work on the crystalline structure of the natural hydrated iron oxides. The Thorlet Prize to Paul Dorveaux. The Marquet Prize to Charles Joyeux, for the whole of his helminthological studies. The Général Muteau Prize to Gaston Ramon, for work on the anatoxins.

Prizes of the Grand Ecoles. The Laplace Prize to Charles Crussard. The L. E. Rivot Prize to Charles Crussard, Jean Hüe de la Colombe, André Brocard and Bruno Cirilli.

General Foundations for Scientific Research. The Gegner Foundation to Claudius Roux, for his work on natural science and the history of science. The Hirn Foundation to Marcel Fouché, for his work in acoustics. The Henri Becquerel Foundation to André Savornin, for his work in terrestrial magnetism.

THE LOUTREUIL FOUNDATION

Researches on Fixed Questions. Henri Erhart (5,000 francs), for the extension of his pedological researches. Albert Henry (3,000 francs), for his researches on parasitism of the mammary gland. Louis Nattan-Larrier (6,000 francs), for the study of the serological conditions of the development of normal tissues and of cancers. Paul Vayssière (3,000 francs), for work on the disinfection and preservation of agricultural products.

Researches to be Carried out in French Colonies. Lucien Berland (8,000 francs), for researches on the entomological fauna of the upper regions of the atmosphere, especially in Senegal. Henri Humbert (6,000 francs), as a contribution to a new botanical expedition in southern tropical Africa and in the north-west of Madagascar.

For Laboratory Equipment. Zéphirin Carrière (10,000 francs), for the purchase of an electrical apparatus for the analysis of sound. Institut national agronomique (10,000 francs), for the purchase of a microscope for the examination of fluorescence by production of ultra-violet rays. Casimir Monteil (5,000 francs), for the purchase of a petrol motor for brake measurements. Henri Thiel (2,000 francs), for the purchase of a Nistri stereographometer.

Publications. Comité de Physique du Globe des Colonies (10,000 francs), for the publication of the "Annales de Physique du Globe de la France d'outre-mer". Fédération française des sociétés de sciences naturelles (4,000 francs), for the publication of the "Fauna de France". Henri Gaussen (5,000 francs), for the publication of a memoir by Charles Flahault on the flora of the French Mediterranean region. Marc Simonet (4,000 francs), for the publication of sixteen coloured plates of certain hybrids of *Iris*. Société Linnéenne de Lyon (3,000 francs), for the publication of library catalogues.

Libraries. Ecole nationale vétérinaire d'Alfort (8,000 francs), for preparing a card catalogue and completing its foreign periodicals. Ecole nationale vétérinaire de Lyon (7,000 francs), for the purchase of foreign veterinary works. Ecole nationale vétérinaire de Toulouse (7,000 francs), for the purchase of French and foreign veterinary works. Ecole polytechnique (5,000 francs), for the purchase of scientific publications. Institut national agronomique (5,000 francs), for the purchase of foreign periodicals. Société astronomique de France (2,000 francs), for increasing its collection of lantern slides. Société d'encouragement pour l'industrie nationale (8,000 francs), for the purchase of foreign works.

MME. VICTOR NOURY FOUNDATION

Edgar Aubert de La Rüe, for his explorations in the French Colonies; Albert Berthelot, for the whole of his studies; Maurice Bouvet, for his work on the history of pharmacy in France; Gilbert Ranson, for his memoir on the medusæ collected during the voyages of Prince Albert I of Monaco; Constantin Toumanoff, for his studies relating to antipaludism in Asia (2,500 francs each).

GENERAL FOUNDATIONS

The Henry Le Chatelier Foundation to Léon Guillet, for his studies on zirconium and beryllium. The Millet-Ronssin Foundation to Justin Savornin (4,000 francs), for his geological work in Algeria; Paul Remy (3,000 francs), for the whole of his zoological work and especially that on insects; Robert Kühner (3,000 francs), for his researches on Basidiomycetes.

VILLEMOT FOUNDATION

Mme. Rose Bonnet-Sainturier (15,000 francs), for the publication of a memoir on the double stars. Lucien Cayeux (15,000 francs), for the purchase of a polarizing microscope and various other instruments. Aimé Cotton (40,000 francs), for the electromagnet laboratory. Alexandre Dauvillier (12,000 francs), for a recording electrometer. Jean Goarnisson (5,000 francs), for the establishment of a laboratory for the preparation of certain remedies against leprosy and sleeping sickness. Edouard Legé (53,000 francs), for experimenting, on a semi-industrial scale, on the synthetic preparation of motor petrol from certain colonial seeds. Charles Maurain (15,000 francs), for researches on terrestrial magnetism and atmospheric electricity. Marin Molliard (5,000 francs), for researches on the morphogenic and physiological action on plants of atmospheric gases under varying pressures. Albert Peyron (8,000 francs), for the development and publication of his studies in comparative pathology relating to tumours. Maurice Piettre (10,000 francs), for the installation of a low-temperature room at the Halles. Gustave Ribaud (10,000 francs), for the experimental study by various methods of the heat losses through the walls of furnaces. Hyacinthe Vincent (12,000 francs), for the purchase of laboratory animals and material for continuing his researches on immunity and pathology of infectious diseases.

SPECIAL FOUNDATIONS

The Lannelongue Foundation to Mme. Gabriel Cusco. The Girbal-Baral Foundation (each 10,000 francs) to Daniel Bouttier and Julien Jouin. The d'Aumale Prize Grants of 5,000 francs each to the widows of Joannès Chatin and Jean Charcot.

Science News a Century Ago

Russian North Polar Expeditions

UNDER the above title, the *Athenæum* of January 27 gave a long account of the exploration of the coasts of Novaya Zemlya based on the memoirs of von Baer contributed to the Imperial Academy of Sciences, St. Petersburg. After referring to the earliest voyages to the north, the writer of the review said: "During the years 1819–24 five well equipped expeditions were despatched by the Russian government for the Survey of Novaïa Semlïa, four of which were under the command of the experienced navigator Lütke; yet they all failed in the especial object of their mission, namely, to trace the eastern coasts of that country." In 1832 a merchant of Archangel named Brandt, equally alive to the interests of science and of commerce, formed a company, and despatched one ship commanded by Lieut. Krotoff to sail along the west coast of the islands and a second in command of the pilot Pachtussoff to survey the eastern coasts. A third vessel sent to the western coast in search of walrus returned richly laden. Lieut. Krotoff and his ship were lost, but Pachtussoff and his party wintered in the north and made valuable surveys.

In 1834 the Russian Government fitted out two vessels, one commanded by Pachtussoff and another by Ziwolka. Leaving Archangel in July, Pachtussoff was away about a year and died shortly after his return. "The two expeditions conducted by Pachtussoff," said the *Athenæum*, "produced a mass of meteorological observations of a very valuable kind, and which bear uniquivocal testimony to the carefulness and assiduity of that officer." The greatest cold experienced in Novaya Zemlya was in February, when the thermometer fell to − 40°. It often remained for days together at −34°.

Karl Ernst von Baer was born in Esthonia on February 17, 1792, and studied medicine at Dorpat. Finding that his native country presented indifferent prospects for a naturalist, he went to Germany and became professor of zoology at Könisberg, where he founded a Zoological Museum. In 1834 he was appointed librarian to the Imperial Academy of Sciences, in which situation he made use of his opportunities to collect information regarding the polar regions of the Russian Empire. He had previous to this become famous for his discovery of the mammalian ovum, which led to his being regarded as the founder of comparative embryology. His death took place at Dorpat on November 28, 1876.

The Zoological Society

AT a meeting of the Zoological Society held on January 23, 1838, Richard Owen being in the chair, Mr. Ogilby characterized several new species of mammals contained in the collection made by Captain Alexander in South Africa, and Mr. Gould described several new and interesting birds included in the collection. Among them was an eagle with a white breast and red tail; two small falcons, scarcely exceeding in size the English house-sparrow; and a very small owl of scarcely larger size. There was also a jay of very gaudy plumage which perches upon the horns of rhinoceros, supposedly for the purpose of obtaining insects; the hunters of the rhinoceros anxiously watch this bird, as when they see it fly up from the horn they know that the animal is alarmed. At the same meeting, Owen read some observations on the anatomy of the giraffe, from dissections made of the animals which died at the Regent's Park and Surrey Zoological Gardens.

The Morse Telegraph

"A NEW and improved transmitting and recording apparatus was completed for Prof. Morse by his partner, Mr. Alfred Vail, of the Speedwell Iron-works, near Morristown, N.J., at the close of the year 1837; and early in January, 1838, Prof. Morse first discarded the numeral signs for words, and employed a true *alphabet* of 'dots and dashes'. The first exhibition of an alphabetic record of words and sentences took place in the New York City University, on January 24, 1838, through ten miles of wire wound on reels. The New York *Journal of Commerce*, in a notice of this performance, remarked, 'Professor Morse has recently improved on his mode of marking, by which he can dispense altogether with the telegraphic dictionary, using letters instead of numbers'." ("A Memorial of Joseph Henry", p. 384.)

Societies and Academies

Paris

Academy of Sciences, December 6 (*C.R.*, 205, 1113–1188).

DIMITRI RIABOUCHINSKY: Hypersonic waves in gases.

LUCIEN DANIEL: New researches on the variations of the reserve function in the autonomous and grafted Jerusalem artichoke.

LUCIEN HIBBERT: Univalence cells of polynomials.

AMÉDÉE GUILLET: The determination of a network of values of the acceleration of gravity (g) centred on a given station.

ALEXANDRE FAVRE: The experimental study of movements in two dimensions by means of the Toussaint-Carafoli hydrodynamic tunnel: the influence of the viscosity.

EMILE MERLIN: A theorem on the motion of fluids deprived of acceleration.

G. A. MOKRZYCKI and J. WYSOCKI: *Décollage* in flight.

JEAN HÉLY: A synthetic theory of gravitation and of electromagnetism.

GÉRARD PETIAU: A system of hypercomplex numbers derived from the system of quaternions.

JEAN ROUBAUD-VALETTE: The passage of vectorial magnitudes to the corresponding spinors by the notion of sub-spaces. The interpretation of Dirac's equations.

GUSTAVE ROBAUD: The calculation of the temperatures and pressures in a closed vessel. The use of a QT diagram, where Q is the total heat necessary for the partial dissociation of the CO_2 and O_2 molecules and to carry the products of dissociation from the temperature T_0 to T, simplifies the laborious calculations hitherto necessary.

GEORGES SIMON and JEAN BOUCHARD: The influence of a longitudinal magnetic field on the thermo-electric power of nickel and of various ferro-nickels submitted to traction.

V. DOLEJŠEK and M. TAYERLE: The separating power in X-ray spectra.

MAURICE COTTE: Aberrations of the second order of orthogonal systems.

CLAUDE MAGNAN: Study of the energies of electrons and positrons emitted during certain nuclear reactions.

AUGUSTIN BOUTARIC: Some simple formulæ relating to adsorption phenomena occurring in mixtures.

WILFRIED HELLER and MLLE. GERMAINE QUIMFE: The isothermal and reversible immobilization of the particles in thixotropic sols.

PAUL MONDAIN MONVAL: The application of the laws of displacement of equilibrium to heterogeneous liquid mixtures.

EMILE CARRIÈRE and MAURICE DELPLA: The comparative action of potassium iodate and of potassium periodate on sodium thiosulphate in weakly acid medium. The oxidation of sodium thiosulphate by iodic acid is markedly influenced by the hydrogen ion concentration, but with periodic acid this concentration has small influence.

MAURICE ANGLADE: The synthesis of the mono-ether oxides of 2,4-dimethylolanisol.

ANTOINE HAUTOT: A method of measuring the periodic internal potential of crystals.

FERNAND JACQUET and MAURICE NICKLÈS: The relations of the eastern Senegal chain with the Mauritanian and Sudanese plateaux.

JEAN MARÇAIS: The tectonic constitution of the eastern French Rif.

ALBERT ROBAUX and MARC BERNATZKY: The tectonic of the secondary strata of Lorraine.

OCTAVE MENGEL: The Robinet of Donzère: its relations with the physiography and seismicity of the Tricastin (Drôme).

B. TROUVELOT and G. BUSNEL: Modifications of the rhythm of the cardiac beats in the larvæ of Doryphora (*Leptinotarsa decemlineata*) produced by the *Solanum* on which they are feeding.

PIERRE DRACH: The morphogenesis of the external crystalline mosaic in the tegumentary skeleton of the brachyurous Decapods.

ALBERT GUIEYSSE-PELLISSIER: The pulmonary vessels with striated fibres of the small mammals.

RENÉ GUY BUSNEL: The biochemical study of the lipins and reducing substances in *Leptinotarsa decemlineata*.

RENÉ COUTEAUX: Origin of the secondary myotubes in the embryos of mammals.

SERGE TCHAKHOTINE: An arrangement (drops of water in a non-miscible liquid) for researches in embryology and experimental cytology.

HENRI NOUVEL: Observation of coition in a species of Mysis, *Praunus flexuosus*.

AUGUSTE TRILLAT and ARTHUR BEAUVILLAIN: An attempt at the aerial transmission of influenza to the ferret through the lungs or eyes.

Moscow

Academy of Sciences (*C.R.*, 16, No. 9; 1937).

N. VEDENISOV: Varieties of E. Čech.

G. N. NEUJMIN: Return to perihelion of the periodical comet Neujmin II in 1937.

J. LARIONOV and A. SEIDEL: Photo-luminescence of solutions of rare earth salts.

H. NEUJMIN: Use of solid indicators for direct detection of photo-dissociation products.

A. E. PORAI-KOSCHITZ and A. I. KULIKOV: A new substantive colouring matter.

A. E. PORAI-KOSCHITZ, B. A. PORAI-KOSCHITZ and S. A. LUICK: Constitution of chinophtalon.

L. S. SELIVANOV: Composition of the mud of the brine of the Karabugaz Gulf.

D. F. PETROV and D. A. TUKAN: Heterozygoty of the male sex in *Fragaria orientalis* Los.

K. E. OVČAROV: Production of thiourea by fungi.

I. A. STEFANOVSKIJ and I. V. GUŠČIN: Specific action of drought on wheat crops at various stages of development.

T. A. KRASSNOSELSKAJA-MAXIMOVA, T. V. KULAGINA, K. I. ORLOVA, L. N. FILIMONOVA and N. V. CUGREJEVA: Physiology of apple trees in relation to soil conditions.

A. JACENKO-CHMELEVSKIJ: Some peculiarities in the conductive system of the petiole of ramie (*Boehmeria nivea*, var. *tenacissima* Gaudich).

M. F. NIKITENKO: Problem of the mechanism of regeneration of the eye lens in Amphibia.

C.R., 17, Nos. 1–2; 1937.

M. M. GREENBLUM: The adjoint transformation.

D. A. FRANK-KAMENECKIJ: The limiting form of the free convection law for high values of Grasshof's criterion.

K. ALEXEEVA: Artificial radioactivity of antimony provoked by slow neutrons.

G. V. GORŠKOV and V. N. IONOV: A new method of determining radium, mesothorium I and radiothorium in sealed preparations.

S. J. TURLYGIN: Effect of electromagnetic centimetre waves on the central nervous system.

A. A. GRÜNBERG and P. M. FILINOV: The hydroxy compounds of quadrivalent platinum (1).

I. PREOBRAŽENSKIJ: Tin-bearing granitoids of Borshchovochny Range, Eastern Transbaikalia.

V. V. AršINOV: The pocket mineralogical or polarizing magnifier.

K. L. POVOLOCKAJA: Vitamin C in germinating seeds.

A. G. ŠESTAKOV and A. P. KAČEEV: Method of rapid determinations of chlorine in plants.

M. F. TERNOVSKIJ, M. I. KHMURA and N. I. ZHUKOV: Inheritance of nicotine and anabasin in inter-specific hybrids with *Nicotiana glauca* Jr.

V. V. BUTKEVIČ: Soil temperature and the effect of fertilizers on the yield and quality of spring wheat.

M. M. GOGOLAŠVILI and N. A. MAXIMOV: Effect of heteroauxin in the rooting of cuttings from subtropical wood.

A. SEREISKIJ and M. SLUDSKAJA: Acceleration of the growth of seedlings and the accumulation of blastanin in the endosperm through the vernalization of spring and winter wheats.

T. T. DEMIDENKO and V. P. POPOV: Periods of absorption of nutrient substances by the sunflower plant in connexion with supplementary feeding.

V. P. POPOV: (1) Influence of daily introductions of nitrogen and phosphorus on the storing-up of hydrophilic colloids in sugar beet. (2) Colloidal chemical composition of sugar beet as determined by the time of introduction of nutrient substances.

M. S. JAKOVLEV: The number of fibro-vascular bundles in the coleoptile of barley and oat.

K. T. SUKHORUKOV and O. B. NATALJINA: The harmfulness of anthracnose of black currant.

I. ŠVAJKOVSKIJ: Aerodynamic properties of insects.

A. A. VOITKEVIČ: Morphogenetic activity of different parts of the hypophysis. (7) The growth-stimulating influence of the "eosinophilous zone" of anterior lobes of the hypophysis, and of other endocrine organs.

G. V. BOLDOVSKIJ: Warm-water Euphausiidæ (Crustacea) of the Murman coast.

Tokyo

Imperial Academy (*Proc.*, **13**, No. 8, 1937).

MOTOKITI KONDÔ: Standardization of complementary analytics.

SÔICHI KAKEYA: Boundary values of analytic functions.

SÔICHI KAKEYA and KINJIRO KUNUGI: A relation between the length of a plane curve and angles stretched by it.

KÔSAKU YOSIDA: The exponential formula in the metrical complete ring.

TETSURO IKEDA: Wearing of the micrometer screw of the Wanschaff zenith telescope. The wearing of the screw is due to the repelling force of the spring.

MANKITI HASEGAWA and YÛITI TAMURA: The regular progressive changes of the magnetic field in diurnal variations of terrestrial magnetism (1).

SHINKICHI YOSHIMURA: Abnormal thermal stratifications of inland lakes. Three kinds of chemical stratifications are designated: (a) biochemical; (b) non-biochemical; (c) combined stratifications of biochemical and non-biochemical origin.

REMPEI GOTO: Positive ion emission from heated nickel wire in oxygen and hydrogen. Oxidized nickel wire heated in oxygen or hydrogen emits some positive ions.

TEIKICHI FUKUSHI: An insect vector of the dwarf disease of the rice plant. Another species of leaf-hopper, *Deltocephalus dorsalis* Motsch., is shown to be a vector of the disease.

TSUNEO EGUCHI: Effects of the length of day upon time of differentiation of the flower bud and the subsequent development to flowering.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, January 24

ENGINEERS' STUDY GROUP ON ECONOMICS (at 64 Great Cumberland Place, W.1), at 8.—Alexander Farquharson: "Frederick Le Play, Engineer and Sociologist".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. C. von Fürer-Haimendorf: "Journeys in the Naga Hills, Assam".

Thursday, January 27

ROYAL SOCIETY, at 4.30 p.m.—E. Gluckauf and Prof. F. A. Paneth: "Identification and Measurement of Helium formed in Beryllium by Gamma Rays".

J. W. J. Fay, E. Gluckauf and Prof. F. A. Paneth: "On the Occurrence of Helium in Beryls".

THE CHEMICAL SOCIETY (at the London School of Hygiene and Tropical Medicine), at 5.30.—Prof. Richard Kuhn: "Synthesis of Polyenes" (Pedler Lecture).

Friday, January 28

GEOPHYSICAL DISCUSSION (at the Royal Astronomical Society), at 4.30.—"The Montserrat Expedition" (Opener: Dr. C. F. Powell).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

JUNIOR SCIENTIFIC OFFICER at the Building Research Station, Garston—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (January 25. Quote J. 38/1).

LECTURER IN ELECTRICAL ENGINEERING in the Wolverhampton and Staffordshire Technical College—The Director of Education, North Street, Wolverhampton (January 27).

HEADS OF THE SCIENCE AND ENGINEERING DEPARTMENTS of the South-West Essex Technical College—The Director of Education, County Offices, Chelmsford (January 31).

ASSISTANT LECTURER IN ENTOMOLOGY in the School of Tropical Medicine, Pembroke Place, Liverpool, 3—The Secretary (January 31).

CHIEF PHYSICIST, AN APPLIED PHYSICIST, AND A COLOUR CHEMIST to the Wool Industries Research Association, Torridon, Leeds, 6 (January 31).

DEPUTY DIRECTOR OF THE IMPERIAL BUREAU OF DAIRY SCIENCE—Prof. H. D. Kay, National Institute for Research in Dairying, Shinfield, Reading (February 5).

MYCOLOGIST in the Plant Pathological Laboratory, Harpenden—The Secretary, Agricultural Research Council, 6A Dean's Yard Westminster, S.W.1 (February 7).

ASSISTANT KEEPER in the Science Museum—The Director of the Science Museum, South Kensington, S.W.7 (February 14).

CHEMIST in the Geological Survey Department, Federated Malay States—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, Westminster, S.W.1 (February 15).

SCIENTIFIC ASSISTANT (veterinary) at the Field Station, Compton, Berkshire—The Secretary, Agricultural Research Council, 6A Dean's Yard, Westminster, S.W.1 (March 1).

JAMES WATT PROFESSOR OF THEORY AND PRACTICE OF HEAT ENGINES in the University of Glasgow—The Secretary (March 1).

CIVIL ENGINEERS in H.M. Naval Establishments—The Civil Engineer-in-Chief, Admiralty, S.W.1.

ABSTRACTOR FROM THE SLAVONIC LANGUAGES at the Imperial Mycological Institute, Ferry Lane, Kew, Surrey—The Director.

VETERINARY RESEARCH OFFICER in Palestine—The Director of Recruitment (Colonial Services), Colonial Office, 8 Buckingham Gate, S.W.1.

RESIDENT ENGINEER (Civil and Building Construction) in H.M. Office of Works—The Chief Architect, Room 65A, Third Floor, H.M. Office of Works, Storey's Gate, S.W.1.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Association of Special Libraries and Information Bureaux. Report of Proceedings of the Fourteenth Conference held at Gonville and Caius College, Cambridge, September 24th to 27th, 1937. Pp. 140. (London: Association of Special Libraries and Information Bureaux.) 5*s*. [812

City of Leeds: College of Technology. Report of the Principal, 1937. Pp. 27. (Leeds: College of Technology.) [812

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1936. Survey prepared by Dr. B. P. Uvarov and Miss W. Milnthorpe. Pp. 55+9 maps. (London: H.M. Stationery Office.) 3*s*. net. [812

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Year 1936. Pp. vi+76+4 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net. [1312

A List of Official Chemical Appointments. Compiled by direction of the Council of the Institute of Chemistry and under the supervision of the Publications Committee. Ninth edition, revised and enlarged. Pp. 415. (London: Institute of Chemistry.) 5*s*. [1312

Royal Technical College, Glasgow. Annual Report on the One Hundred and Forty-first Session adopted at the Annual Meeting of Governors held on the 26th October, 1937. Pp. 93. (Glasgow: Royal Technical College.) [1312

P E P (Political and Economic Planning). Report on the British Health Services: a Survey of the Existing Health Services in Great Britain with Proposals for Future Development. Pp. iv+430. (London: P E P.) 7*s*. 6*d*. net; cloth, 10*s*. 6*d*. net. [1412

British Film Institute. Fourth Annual Report, Year ended 30th June, 1937, presented to the Annual General Meeting, 4th November 1937. Pp. 27. (London: British Film Institute.) [2212

National Smoke Abatement Society. Eighth Annual Report, 1937–8. Pp. 32. (London: National Smoke Abatement Society.) [51

Metropolitan Water Board. Thirty-first Annual Report on the Results of the Chemical and Bacteriological Examination of the London Waters for the Twelve Months ended 31st December, 1936. By Lieut.-Colonel C. H. H. Harold. Pp. 117. (London: P.S. King and Son, Ltd.) 10*s*. 6*d*. [51

North-East Development Board. The Barytes, Fluorspar and Lead Resources in Upper Teesdale and Weardale. By Prof. Granville Poole. Pp. ii+10. (Newcastle-on-Tyne: North-East Development Board.) [51

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Thirtieth Annual Report, 1936–37, presented by the Council to the Court of Governors on the 22nd October, 1937. Pp. 48. (Cardiff: National Museum of Wales.) [51

The Examination of Colliery Ropes in Service. Pp. 37. (London: H.M. Stationery Office.) 3*d*. net. [51

Huddersfield Technical College. Report of the Principal, 1936–37. Pp. 8+8+2+3. (Huddersfield: Technical College.) [51

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